Section 6
ASSET TUTORIAL
FOR
SURFACE COMBATANT DESIGN

6.1 INTRODUCTION

In this section, you will learn more about ASSET by practicing the execution of the program. A practice ship design has been included showing, step by step the design process employed when using ASSET as a design tool. This tutorial covers the entire ASSET-aided design process, from design requirements, to inputting and running each module, to running synthesis to obtain a converged model, to design refinements.

ASSET can be used for various tasks within the domain of naval architecture. One of the most common uses of ASSET is performing design trade-offs for a pre-existing ship design. In this case, the user quickly sees the effect of design changes to a particular design. In the following tutorial, the goal is to acquaint the user with as many aspects of the program as possible. For this reason, the tutorial you are about to begin will start with a "blank sheet of paper." You will not be performing changes to a pre-existing ship but, instead, you will work from a list of requirements to generate a new ship design. This process will cover all of ASSET's modules in the surface combatant program, MONOSC. At the end of the tutorial you should have a better understanding of how ASSET operates and what information it requires from the user.

Note: This tutorial assumes that you are familiar with the principles of naval architecture. This assumption has been made to keep this tutorial focused on the usage of ASSET and not on a crash-course in naval architecture.

Note: At various points in this tutorial, you should save your current model to the data bank. Name it whatever you like as long as you don't use a name of a pre-existing ship/component, module, or parameter. To save it to the data bank for the first time, use the **Store** command under the **Ship** menu of the menu bar. To update the saved model with the current model (i.e. to save the current model to a name already existing in the data bank), use the **Modify** command. You might want to save the model under a different name each time you complete a computational module. This way, you can always restart a module without worrying about parameters you might have set incorrectly in the previous run.

6.2 DESIGN REQUIREMENTS

To start the design, the following requirements were generated:

Ship Type

Frigate

Ship Performance

Sustained Speed: 24 knots

Endurance: 4,000 nautical miles @ 18 knots

Combat Systems (payload)

1 32 cell VLS

1 76mm Deck gun

2 CIWS mounts (1 fwd, 1 aft)

1 SQ5-56 Sonar

2 LAMPS III Helos with hangar, landing area, fuel, stores, ammo

1 SPS-49 2-D Air search radar

1 MK X11 AIMS IFF

1 MK 92 Fire control system

STIR Gun control director

CAS Missile control

1 SPS-67 Surface search radar

1 SQQ-89 Underwater- fire control

1 SQR-19 TACTAS

1 SLQ-25 NIXIE2

2 MK 32 SVTT Triple torpedo tubes

MK 46 Torpedoes- 6 in tubes, 12 in magazine

Propulsion Plant

2 Propulsion shafts

2 Main machinery rooms (MMRs) with at least 1 compartment separation

4 Main diesel engines

2 Auxiliary machinery rooms (AMRs)

4 Diesel generator sets (ship's service)

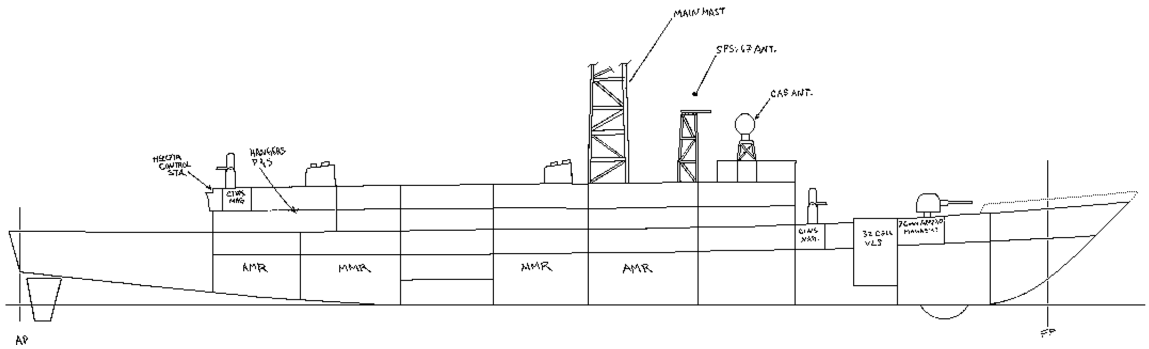
Manning

	Ship's Crew	Aviation Detachment
OFF (officers)	12	6
CPO (chief petty officers)	15	1
OEM (other enlisted men)	140	13

All other systems as appropriate for a U.S. Navy frigate

6.3 INBOARD PROFILE

The first step in the design is to create a preliminary inboard profile of the frigate. With the profile, an estimate of the ship's length can be measured. Length will be one of the first parameters you will need to input to ASSET. Figure 6.1 shows the preliminary inboard profile used in this tutorial.

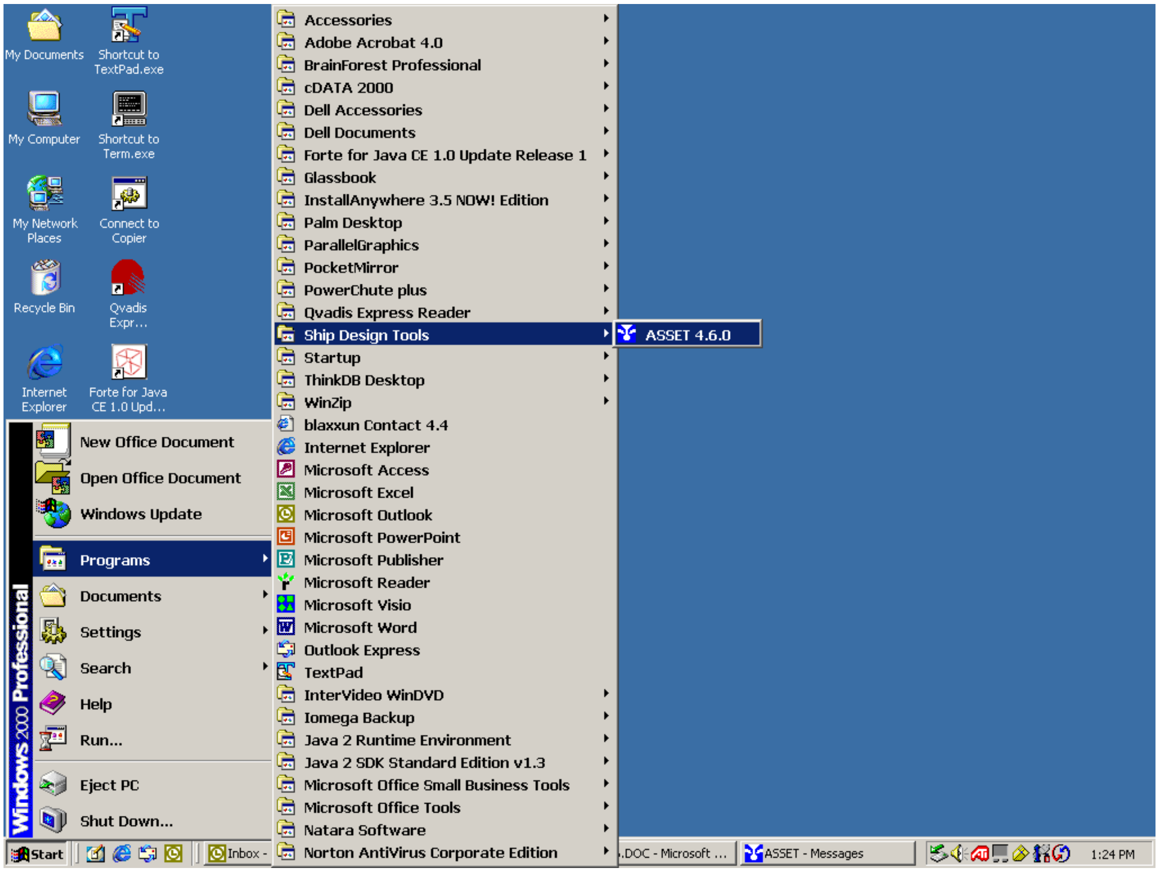


Since weather deck space often determines much of the ship's length, placing the designated combat systems on deck started the inboard profile. After positioning as many deck-mounted combat systems as possible, the machinery rooms were added to help define the portions of the ship where deck area was not the limiting factor. An estimate of machinery room length was taken from pre-existing designs. The same was done for the deck space required by mooring gear.

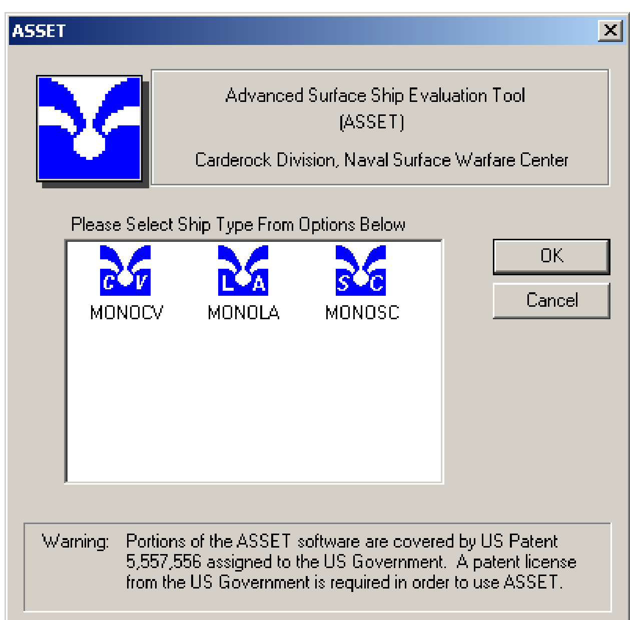
With the preliminary inboard profile complete, the length of the ship was estimated as 131m. Although the deckhouse has been added, this is a first estimate of deckhouse length, and will not be seriously considered until ASSET begins to calculate space requirements.

6.4 STARTING ASSET

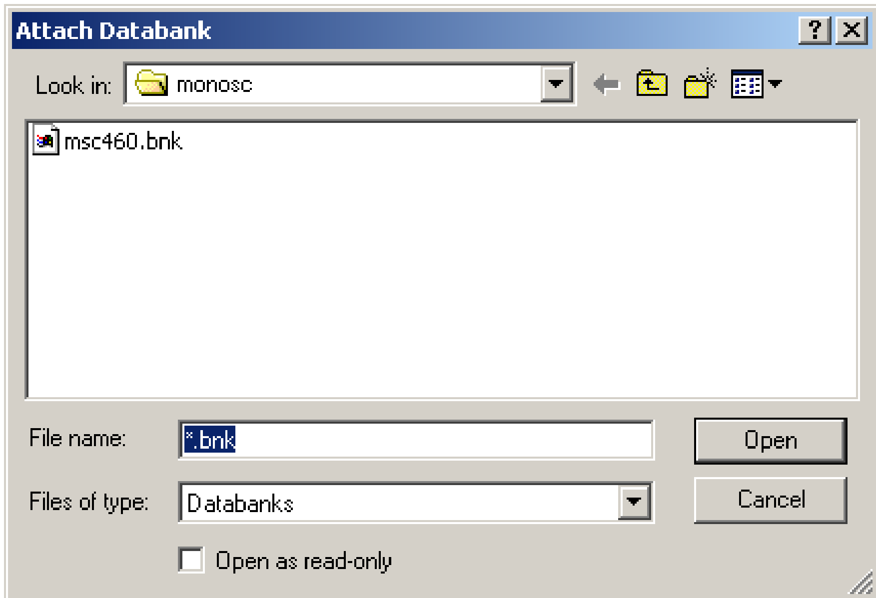
Start ASSET by selecting the ASSET menu item from the Start Menu. It should be in the Ship Design Tools folder.



The first dialog box to appear prompts the user to choose a ship-type-specific program from ASSET's family of programs. Since we are designing a frigate, choose the MONOSC command button. The dialog box looks like this:



The main window for ASSET will be displayed, and the Attach Databank dialog will appear. Since you will be using information stored in the **msc460.bnk** data bank, select **msc460.bnk** from the file list and click **OPEN**. The dialog box will look like this:



After attaching the databank, the three output windows (Messages, Printed Reports, and Graphic Reports) will appear. Notice the status bar; it is indicating that the MONOSC program is running, that you have attached the **msc460.bnk** and that ASSET is ready for the next command.

Note: The number in the data bank name indicates which version of ASSET you are using. You may have an earlier version than Version 4.6.0.

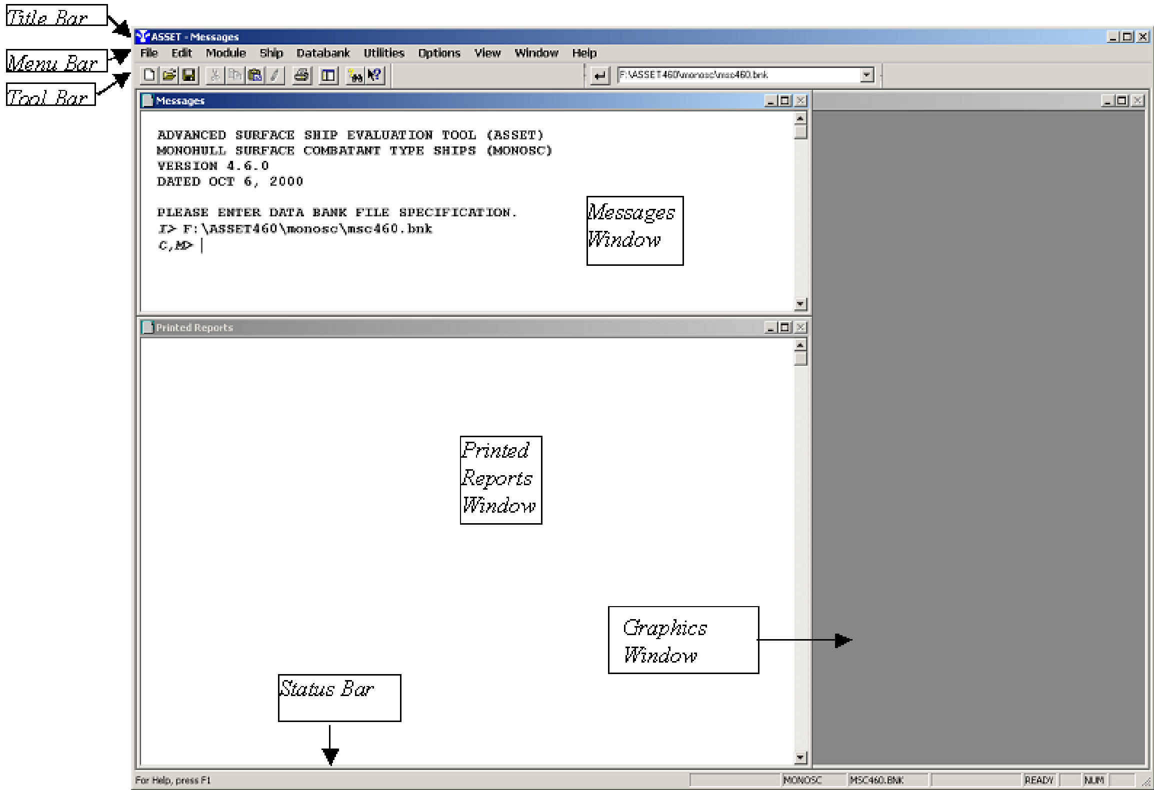


Figure 6.1 - ASSET's Main Window

If this is the first time ASSET as been run on you computer, you may wish to arrange the windows into their default positions. From the Menu bar select **Window⇒Arrange Windows**. This will position the windows to their default positions. Now from the Menu bar select **Window⇒Save Positions At Exit**. This will save the current window positions when you exit ASSET, so that the next time ASSET is run, the saved locations will be used.

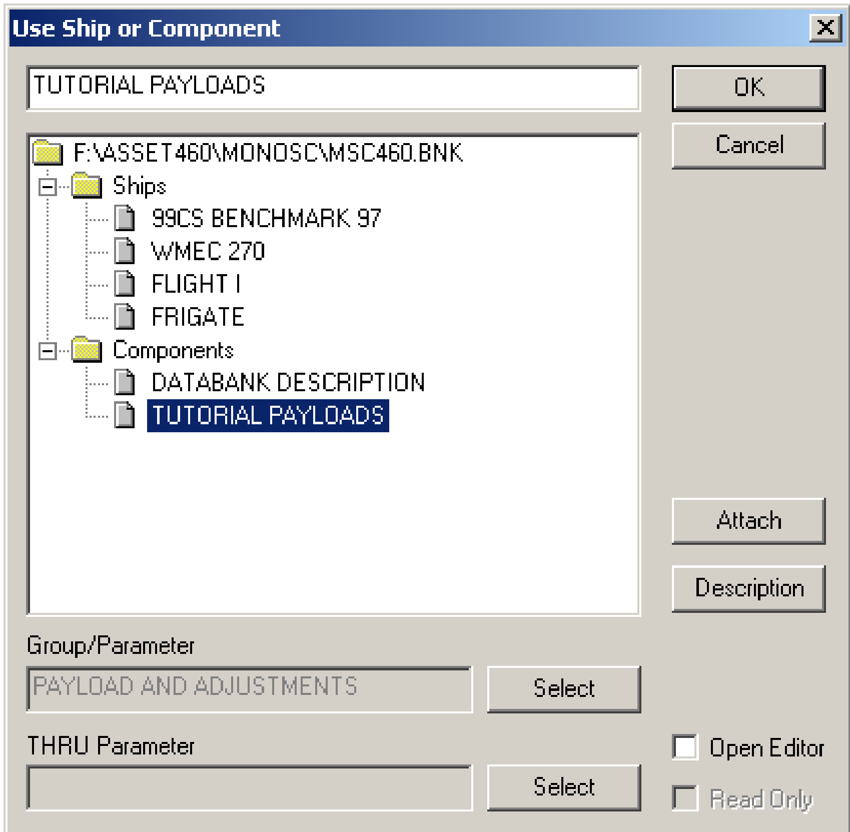
6.5 PAYLOAD AND ADJUSTMENTS

The first item to develop after creating the inboard profile is the ship's payload. Payload items, such as weapons and combat systems, must be input into ASSET. Most payload items require input of weight, arrangeable area, and electric load. All of the payload information needs to be entered in the PAYLOAD AND ADJUSTMENTS group. Payloads are discussed in more detail is Section 5.3. Since modeling payloads can take a sizable portion of time, this has already been done for you. A component named **MONOSC TUTORIAL PAYLOADS** is stored in the data bank. Don't worry, you'll get a chance to edit this payload and see how it was created.

This component was created by taking portions of pre-existing models and compiling the needed information into **MONOSC TUTORIAL PAYLOADS**. If no data exists for a particular payload item, the user would need to enter the information into the current model's PAYLOAD AND ADJUSTMENTS group. You will see exactly what data are needed in just a moment.

The first thing you need to do is to make the component **MONOSC TUTORIAL PAYLOADS** part of the current model. Do this by clicking on **Ship** from the menu bar and then selecting **Use**.

The Use **Ship or Component** dialog box will appear. Select the **Components** folder, click on **MONOSC TUTORIAL PAYLOADS** and select **OK**.



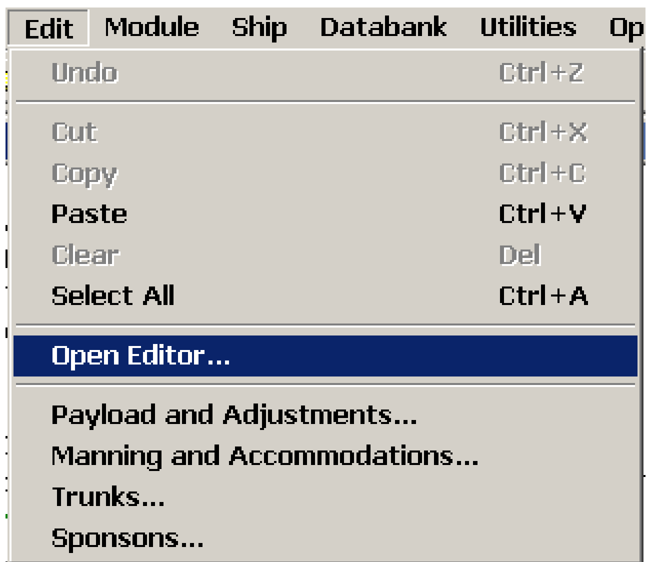
In the messages window you should see the command string USE, MONOSC TUTORIAL PAYLOAD echoed. An executive program confirmation will be displayed, which should look like this:

```
C,M> USE, TUTORIAL PAYLOADS, PAYLOAD AND ADJUSTMENTS
** CONFIRMATION - EXECUTIVE PROGRAM ** (C-COMPALLUSEOK-USE)
ALL OF COMPONENT 'TUTORIAL PAYLOADS' HAS BEEN USED.
C,M> |
```

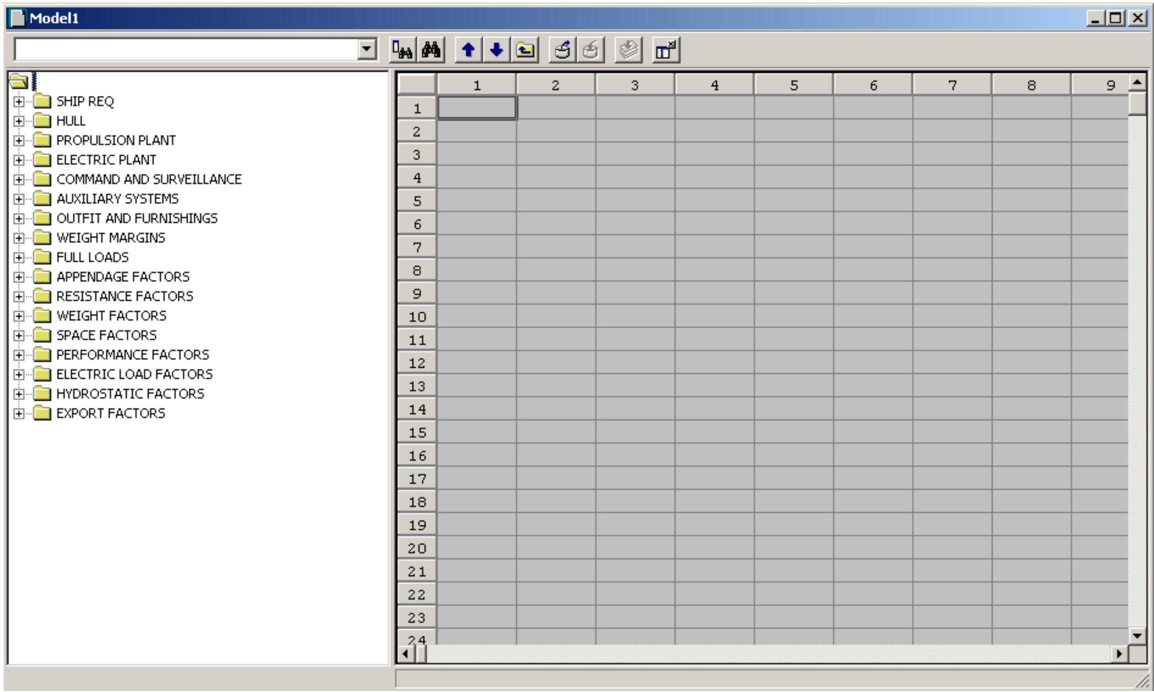
Just to recap, so far you have:

- Started the ASSET monohull, surface combatant program, MONOSC.
- Attached the data bank named msc460.bnk.
- Used the component **MONOSC TUTORIAL PAYLOADS** from the attached data bank and made it part of your current model.

The only information in the current model is the payload for your frigate design. You will enter all other required information as you work through the following sections of this tutorial. Before you move on, look at the payload information you brought into your current model. You can accomplish this two ways, either using the EDIT command or the Payload and Adjustment Dialog. The EDIT command will put you in the editor where you can view data in a spreadsheet format. The Payload and Adjustment Dialog is a specialized dialog for editing the PAYLOAD AND ADJUSTMENTS. To acquaint you with ASSET's editor, use the EDIT command. From the **Edit** menu (located in the menu bar), select **Open Editor**.



Once you have selected the Open Editor, the Edit window will appear. It will look like this:



A dialog box is above the parameters. Type "PAYLOAD AND ADJUSTMENTS" in the dialog box and click on the **Jump To** button. The **Jump To** button is the first button beside the dialog box. As you can see, the SHIPS REQ folder automatically scrolls to show the four groups that are within it. One of these folders is PAYLOAD AND ADJUSTMENTS. The editor appears and is showing the Payload and Adjustments information in the current model. This is depicted in Figure 6.2. It should be noted here that this tutorial will be using metric units. ASSET defaults to this setting so no adjustment is necessary (under the *Options* menu).

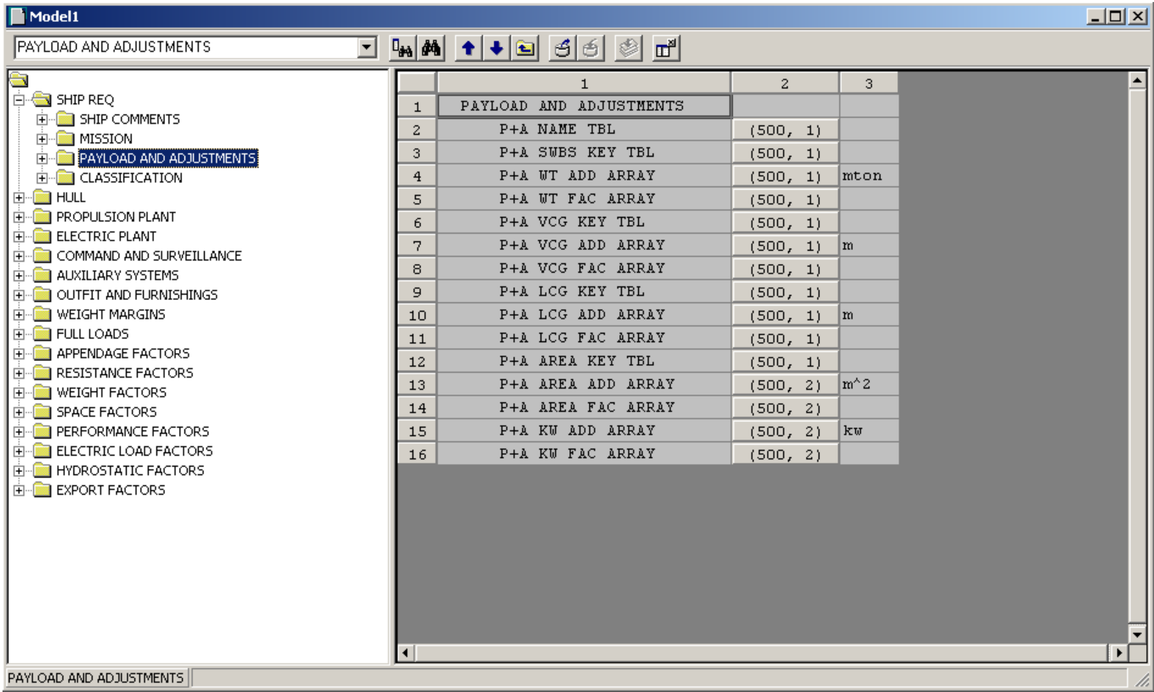


Figure 6.2 - ASSET Editor Showing P+A Data

To view the data, move the cursor to the desired array and hit return. There are twelve columns of information, each pertaining to a specific attribute of the payload. The first is the “P+A NAME TBL”. This table will give you the names and descriptions of the payload items. Following the name table is the “P+A SWBS KEY TBL”, which contains the SWBS numbers for each item. The remaining parameters contain information about the Weight, VCG (Vertical Center of Gravity) location, Area requirement, and Electric load (Kilowatts-KW) of each payload item. Each row of PAYLOAD AND ADJUSTMENT data relates to the same payload item. For example, all the information in row #1 of each PAYLOAD AND ADJUSTMENT table or array relates to the item described in row #1 of the P+A NAME TBL.

The PAYLOAD AND ADJUSTMENT parameters allow the designer to adjust the weight, required area and electric load algorithms within ASSET, as well as, input data for groups where algorithms do not exist. For each attribute (weight, area, or electric load) there are three values: a key, a factor, and an addition. (The electric loads use the P+A SWBS KEY TBL.) These three values are used to calculate the adjusted weight, area, or electric load following an equation of the form Net = Calc + Fac*Calc + Add where;

Net	=	The final adjusted weight, area or electric load.
Calc	=	The value calculated by the internal ASSET algorithm.
Fac	=	The value in the P+A factor array (i.e. P+A WT FAC ARRAY)
Add	=	The value in the P+A add array (i.e. P+A WT ADD ARRAY)

Tables 5-1 and 5-2 list the weight and area groups where ASSET MONOSC does not have internal algorithms. For these groups, Calc = 0 and an appropriate value must be entered in the “Add” array. The parameters relating to VCGs (and LCGs) also use three values, a key, a factor, and an addition, but they are applied in a different manner. When inputting data to the PAYLOAD AND ADJUSTMENT parameters relating to VCGs and LCGs, you are specifying the location of the weight adjustment defined by the P+A WT FAC ARRAY and the P+A WT ADD ARRAY in the corresponding row. There is no way to directly adjust the VCG or LCG calculated by the internal ASSET algorithms. The three values are used to specify the VCG location of the weight increment following an equation of the form VCG = Fac*Key + Add where;

VCG	=	Vertical center of the weight increment defined by the P+A WT FAC ARRAY and the P+A WT ADD ARRAY
Fac	=	The value in the P+A factor array (i.e. P+A VCG FAC ARRAY)
Key	=	One of the reference locations allowed in P+A VCG KEY TBL. (For example, D10, which is the hull depth at station 10.)
Add	=	The value in the P+A add array (i.e. P+A VCG ADD ARRAY)

For example, let's say that payload item's VCG is to be located 1m above half the depth of the ship. In the VCG key table, the key would be D10, meaning the depth at station 10. The factor would then be 0.5 and the addition would be 1. This would yield the VCG location of item = 0.5(D10) + 1, which would place the VCG 1m above half the depth of the ship (measured from the baseline).

Move around the editor, looking at the parameters for the payload items. Familiarize yourself with editor commands and the arrays and tables in the PAYLOAD AND ADJUSTMENT group. Additional information can be found in the on-line help. To obtain information on a particular parameter, say the P+A AREA KEY TBL, click on **Help** in the menu bar and choose **Index** from the menu. A dialog box appears, prompting you to **enter the parameter** for which you want it to search (Figure 6.3).

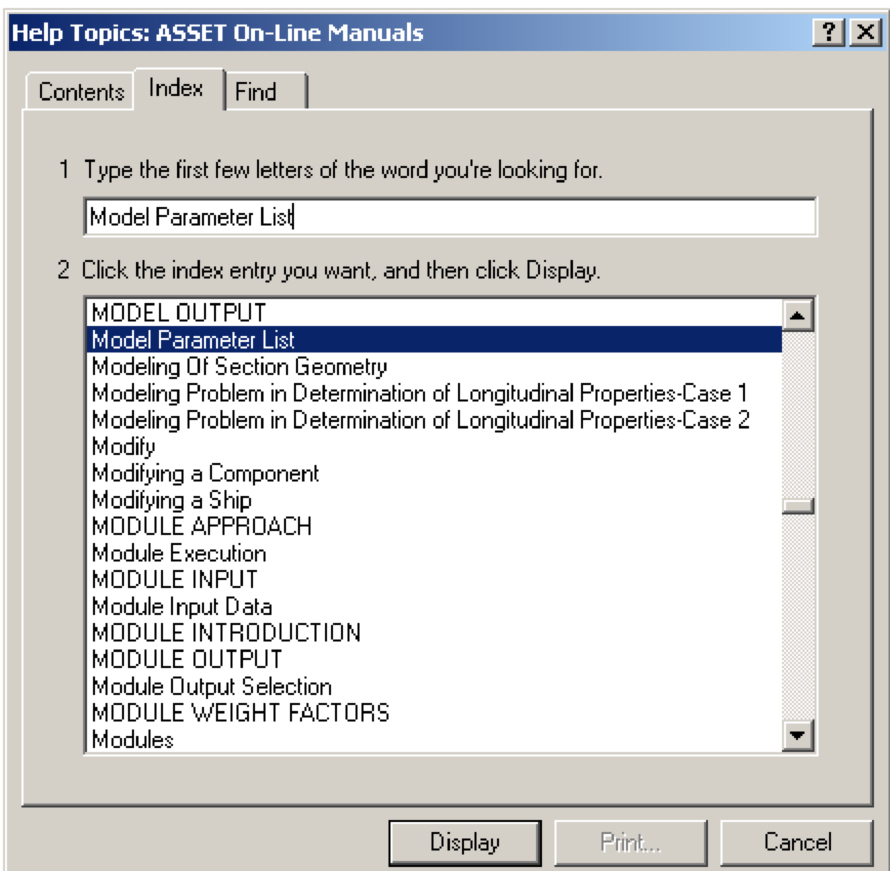
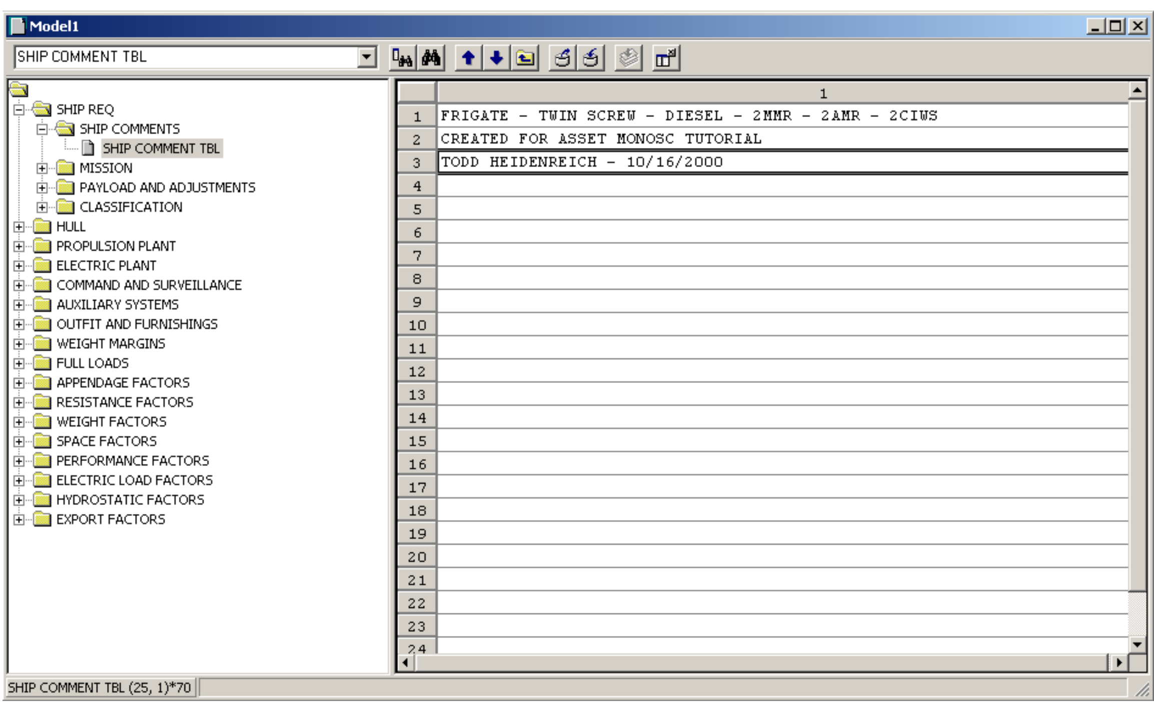


Figure 6.3 - *Index* Dialog Box from the Help Window

In the text entry box, type the letter p. Notice that the parameters beginning with the letter p appear. Click on P+A AREA KEY TABLE and click the **Display** command button. The information relating to the selected parameter is displayed. The search command is extremely useful and can be used to obtain the definition of any parameter to which the remaining portions of this tutorial.

Close both the help session and the editor. Before going any further, it is a good idea to insert a description of the ship into the current model. A table exists (SHIP COMMENT TBL) that is designated to contain a description of the model. The ship comment table should contain the type of ship, distinguishing characteristics, the designer's name, last date of modification, and anything else deemed pertinent.

In the command text box, type **EDIT, SHIP COMMENT TBL**. This command brings up the ASSET editor. Press the **Enter** key to display the contents of the parameter-- it should be blank. Type the ship description. The SHIP COMMENT TBL contains 25 rows. Each row can contain up to 70 characters. Below is an example of a ship comment table for the design in this tutorial.



Now that the table is complete, save the new data to the current model and exit out of the editor by selecting **File⇒Close⇒Yes** (save).

If you have not already done so, store your ship to the databank at this time (**Ship⇒ Store⇒**type in **ship name⇒OK** box or **File⇒Save As⇒**type in s**hip name⇒OK** box). A ship name can be up to 25 characters long. Blanks are allowed. Note that your ship name is now listed on the Status Bar.

You can view the SHIP COMMENT TBL by pressing the **Description** command button located in the **Use Ship** Dialog box (**Ship⇒Use⇒ship's name⇒Description**). This feature is helpful in finding a particular design in a data bank containing many ships.

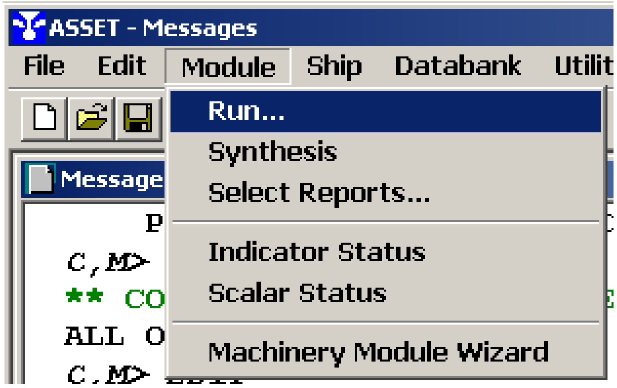
6.6 HULL GEOMETRY MODULE

So far in the design, the inboard profile has been created, a preliminary length has been estimated, and the payload has been modeled in ASSET. With this accomplished, you are now ready to execute ASSET's computational modules. You will be running them one at a time in "prompt mode." Here, you will be entering design data, as ASSET requires it to run the modules. The modules will be run in the order in which they are listed in the **Module⇒Run** dialog box. When starting a new design the modules should always be run in this order. The first module to be executed is Hull Geometry.

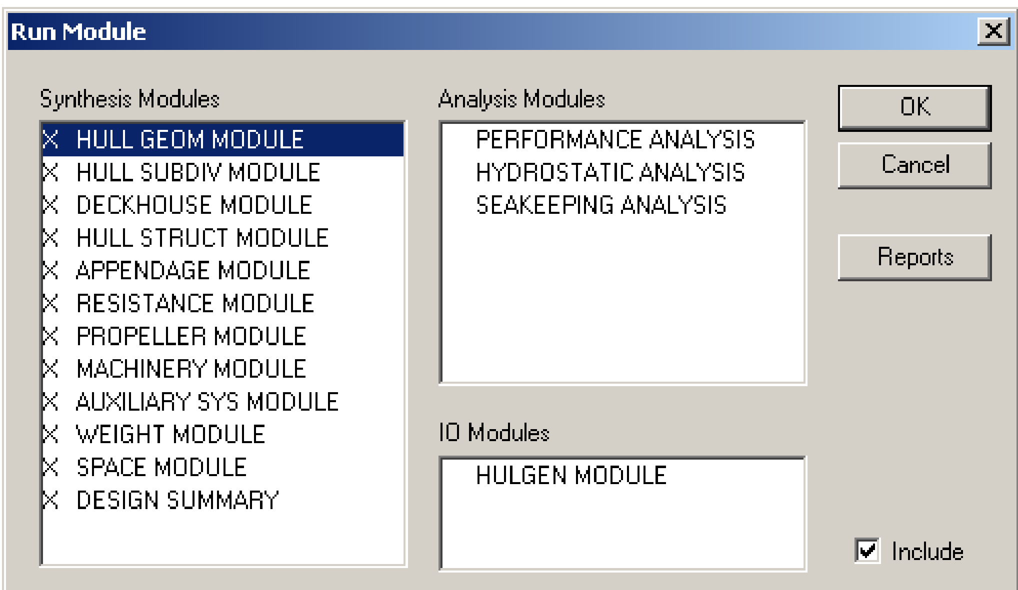
The Hull Geometry Module defines the geometry of the molded hull form via a set of offsets. In this module, you will allow ASSET to generate a hull form based on a few hull parameters.

Before running the Hull Geometry Module, ensure the ship that you stored in the previous section is in the Current Model. The ship name should be listed in the status bar along the bottom of the ASSET window. If it is not listed, retrieve your ship from the databank as described in Section 6.5.

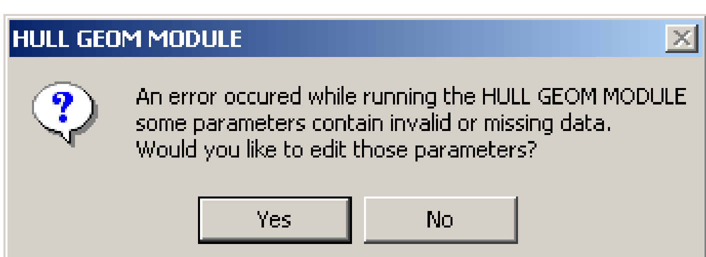
To run the Module, go to the Module menu and go to the **Run** command:



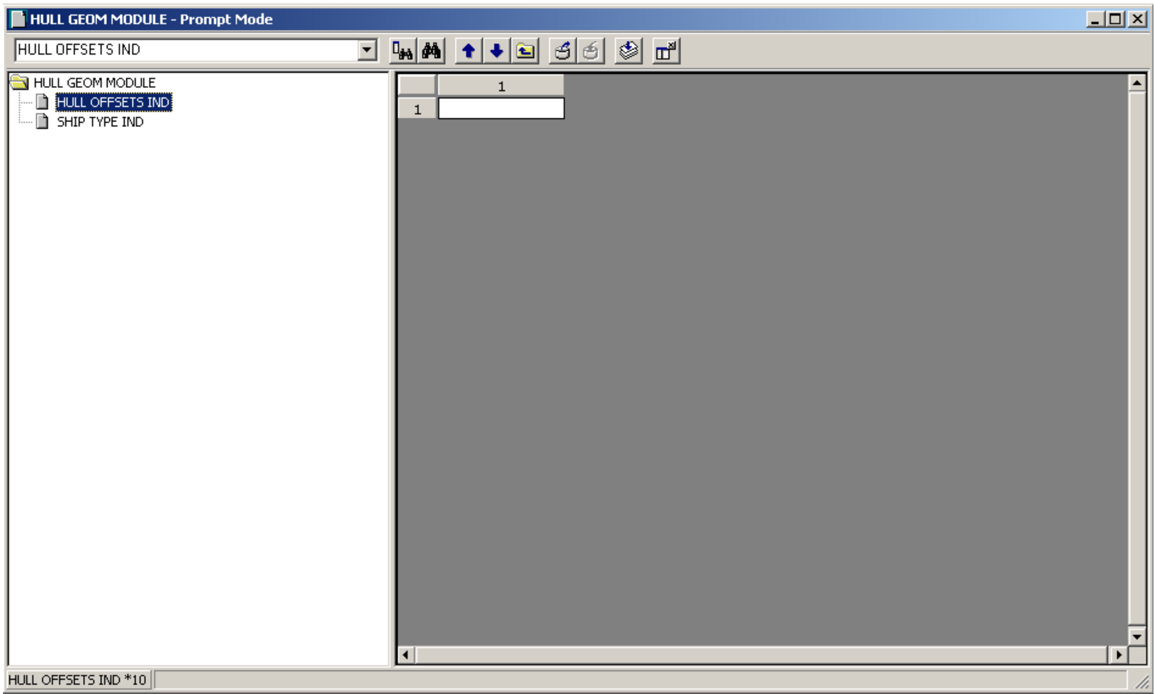
After clicking the Run command, a dialog box appears that looks like this:



Highlight the HULL GEOM MODULE. Click **OK**. ASSET will return with an error message that looks like this:



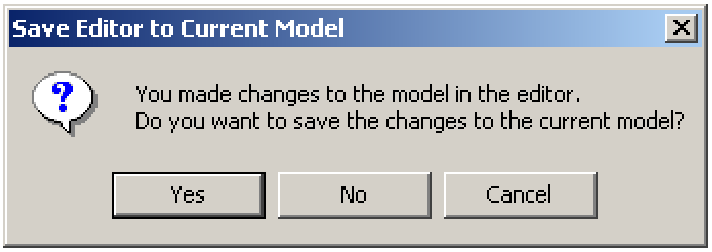
After clicking “Yes”, the Editor opens to the Hull Geometry Module—Prompt Mode.



ASSET is prompting you to enter data for two parameters, the HULL OFFSETS IND and the SHIP TYPE IND. Each has a drop down window, which will reveal options that you can choose. You can access the definition of the parameter highlighted in the tree view of the Editor by pressing the right mouse button and selecting **What's This** from the menu. For each parameter, choose the following options:

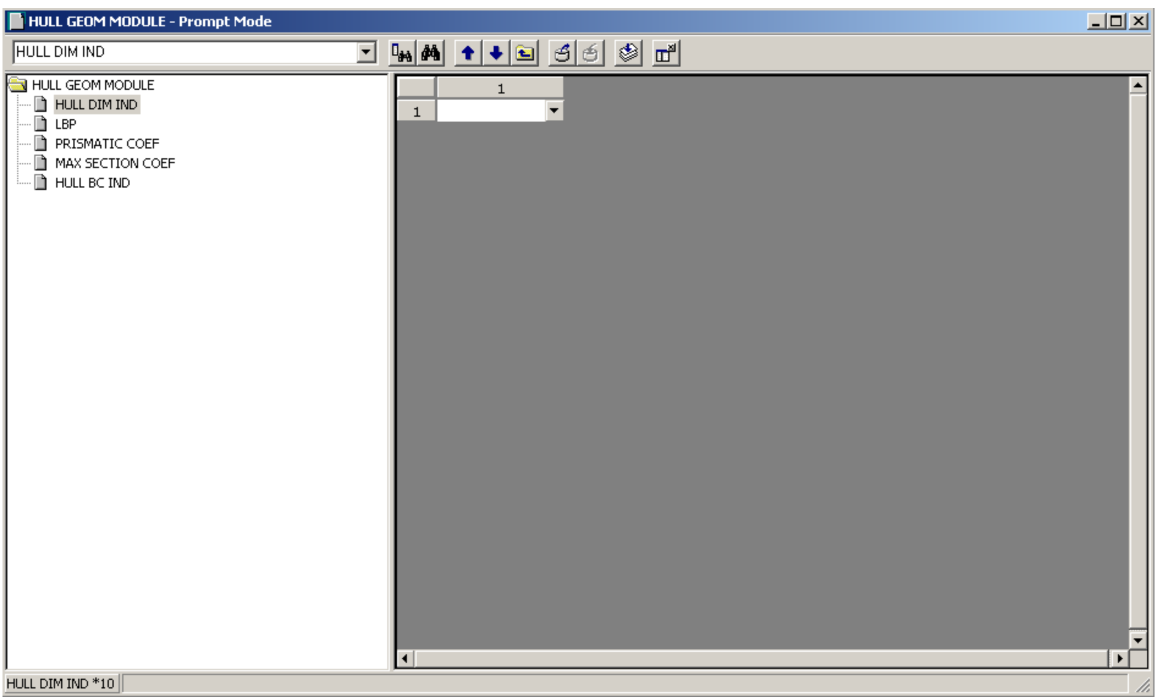
HULL OFFETS IND: **GENERATE**
SHIP TYPES IND: **SC**

The reason **GENERATE** is selected for the HULL OFFSETS IND is that you want ASSET to generate as much data as possible. If you had chosen **GIVEN**, ASSET would later ask you to supply more data. Since our example is a frigate, we also want the SHIP TYPE IND to reflect that. After entering the data, a message will appear that looks like this:



If this message does not appear, click the **Run** button on the Editor. This will run the Hull Geometry Module again and the above message will appear.

After clicking "Yes", another error message will appear again, informing you that it had a problem running the Hull Geometry Module and would you like to input more data. After clicking "Yes", this is the next dialog box to appear:



The parameters that will require data are the HULL DIM IND, LBP, PRISMATIC COEFF, MAX SECTION COEFF, and HULL BC IND. Use the on-line help to get information on all the parameters. Since you want ASSET to do as much calculating as possible, the data to input for the HULL DIM IND and LBP are:

HULL DIM IND = **B+D+T**
LBP = **131 meters**

Again, if you choose **GIVEN**, ASSET will later prompt you to give more information. The LBP was calculated from the Inboard Profile as described in Section 6.3. All measurements will be given in metric system units.

The next two parameters are the prismatic and max section coefficients. ASSET requires you to enter values for these parameters. A good source for estimating these coefficients is An Approach to Technology Assessment in Naval Ship Applications, DTRC-SD-90/21, March 1991, written by Wintersteen, Gallagher, Jones, Read, Hilaire, and Walker. These equations require a first estimate of full load displacement. Use the following equation to estimate full load displacement.

$$CircleM = \frac{L_{BP}}{\sqrt[3]{0.975 * \Delta}} = 7.5$$

Where: Δ = full load displacement (metric tons)

L_{BP} = length between perpendiculars (meters)

From this equation you can calculate a first estimate of your frigate's displacement Δ = 5,465 MT (5,378 LT). Using this displacement, calculate the prismatic and section coefficients from the following equations (See page 24 of the above publication). **Be careful of units since you are working in metric in ASSET and these equations are in English units.**

$$C_x = 0.743539 + 0.000013\Delta - 4.15999 \times 10^{-10}\Delta^2 + 4.917054 \times 10^{-15}\Delta^3$$

$$C_p = 4.067678 - 9.515995\frac{V}{\sqrt{L_{BP}}} + 9.413578\left(\frac{V}{\sqrt{L_{BP}}}\right)^2$$
$$-4.004274\left(\frac{V}{\sqrt{L_{BP}}}\right)^3 + 0.623543\left(\frac{V}{\sqrt{L_{BP}}}\right)^4$$

Where: C_x = maximum section coefficient

C_p = prismatic coefficient

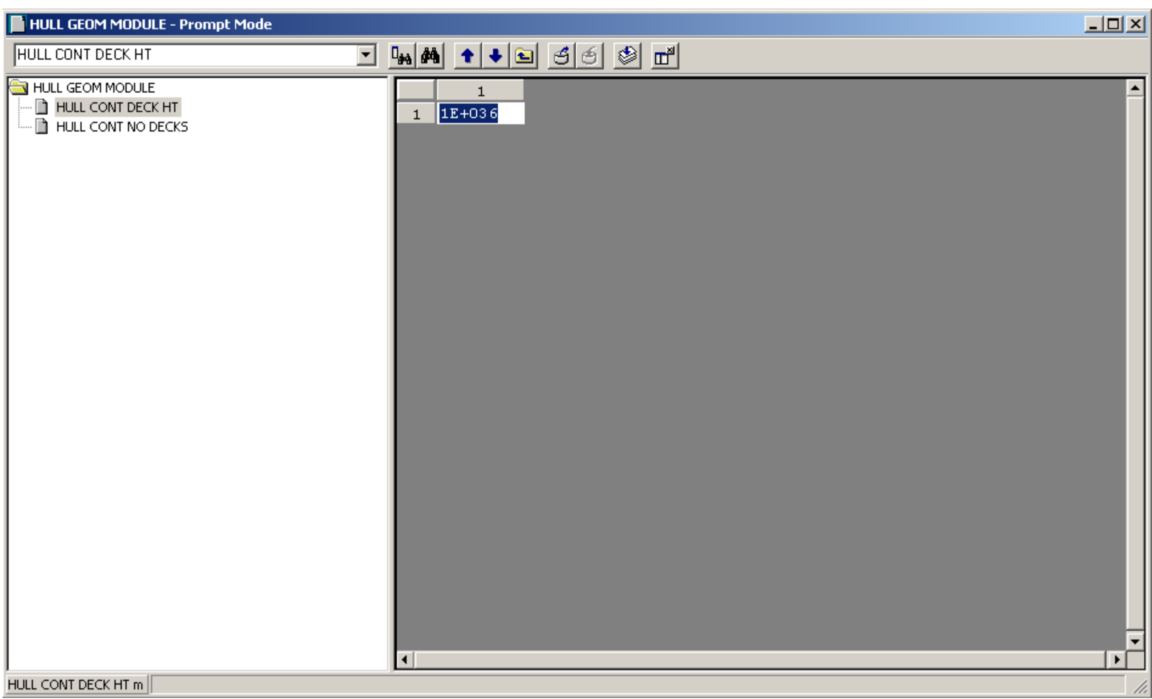
V = maximum speed (knots) (For first estimate, use sustained speed from list of requirements plus 1 knot)

Working through the preceding equations, you should obtain the following solutions:

$$C_p = \mathbf{0.5782}$$

$$C_x = \mathbf{0.8022}$$

Enter these two coefficients into your model. The last parameter listed, HULL BC IND, should be set to **DDG51**. After you have entered these parameters in the model, the Save Editor to Current Model message should appear, and it asks if you want to save the changes you have made to the model. If this message does not appear, click the **RUN** button on the Editor. This will run the Hull Geometry Module again and the message will appear. After clicking “Yes”, the Hull Geom Module error message will appear. It asks if you want to enter the missing or invalid data. After clicking “Yes”, the following dialog box will appear:

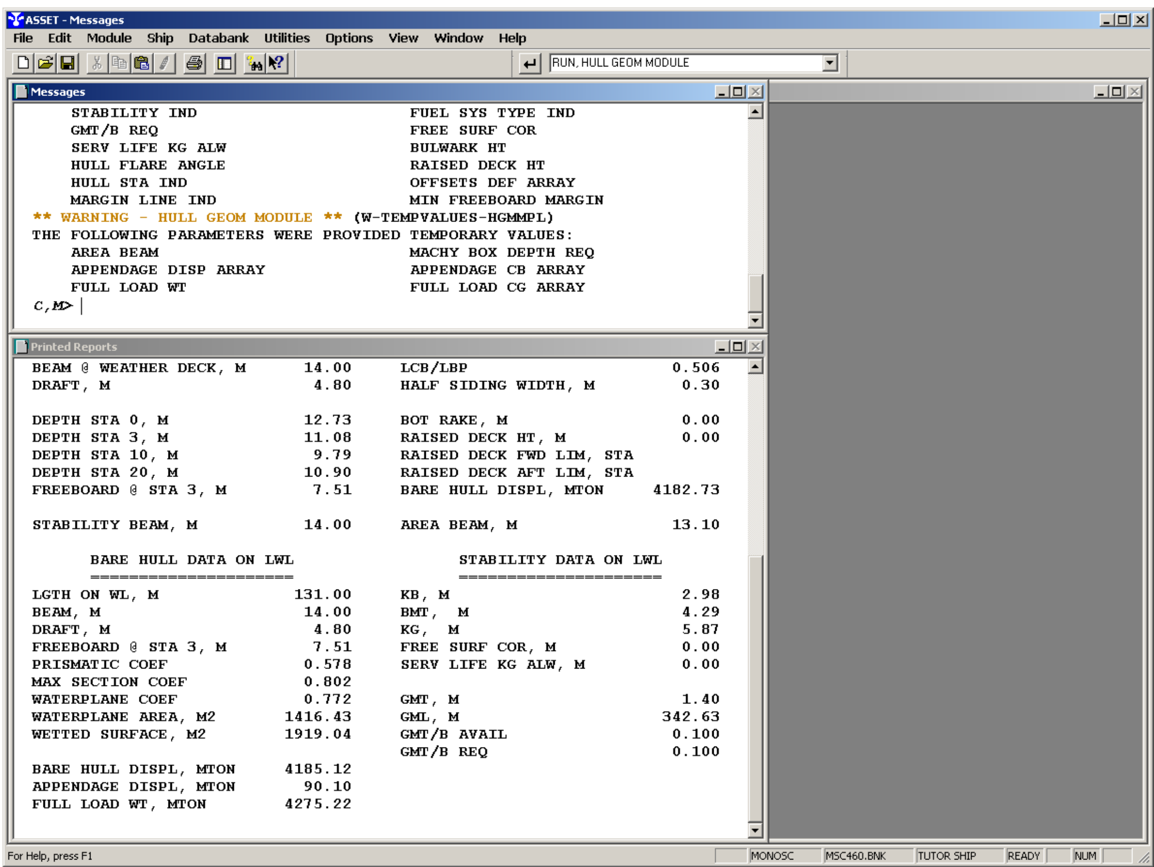


The next parameters ASSET will request data for are HULL CONT DECK HT and HULL CONT NO DECKS. Use the on-line help to clarify these parameters (Click the right mouse button and select **What’s This**). Set the values for these parameters to:

HULL CONT DECK HT = **3.0**
HULL CONT NO DECKS = **1**

The value **3.0** is a first estimate on deck spacing and the number of continuous decks (**1**) was taken from the inboard profile.

After these inputs are entered, the Save Editor to Current Model dialog will appear. It asks if you want to save the changes you made to the current model; therefore, click "Yes". This time, the Hull Geometry Module will run, and the Message and Printed Reports windows will look like this:

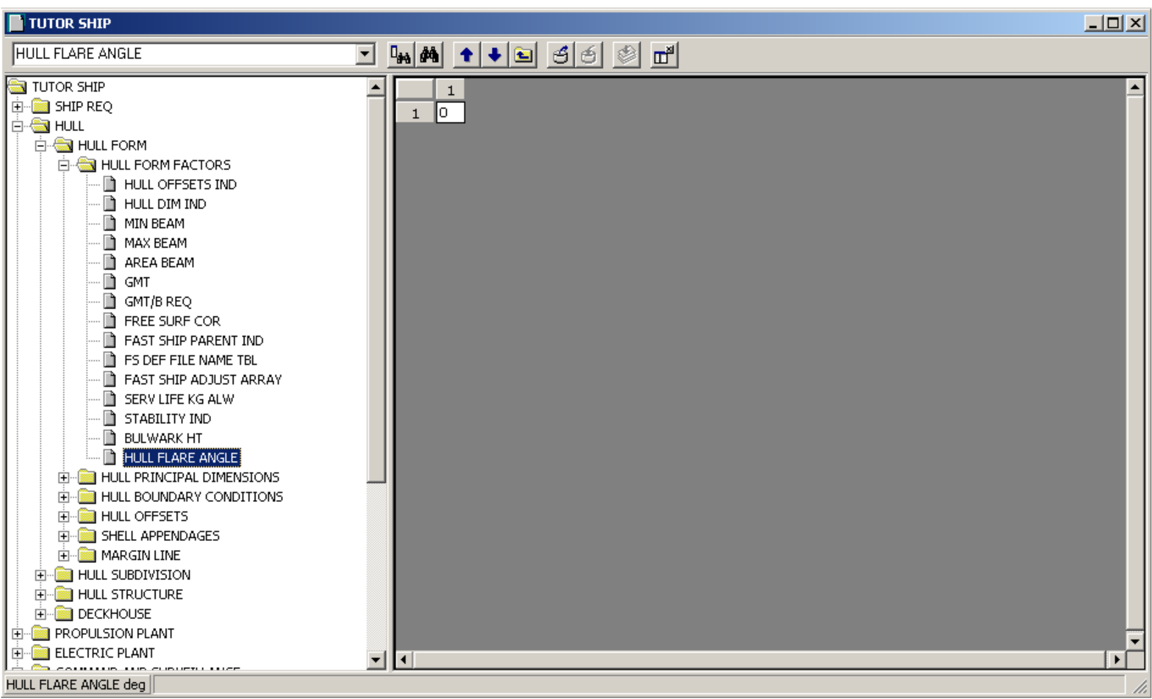


In the Message window, ASSET shows what parameters were defaulted or given temporary values when the run was made. See Section 3.4.2.3 for an explanation of temporary and default values.

It is a good practice to review what parameters were provided default values. In some instances, you might be able to set the parameter to a user-known value. In other cases, you might want to just check the parameter to make sure ASSET has not defaulted to an inappropriate value. Parameters set to temporary values are not a concern at this point because these values are not saved to the Current Model. The appropriate module will set these parameters when that module is run.

You may want to save your ship at this time. To save it, go to the Ship menu, click **Modify** and a window will appear that asks you to name your ship. Give your ship a name and click **OK**.

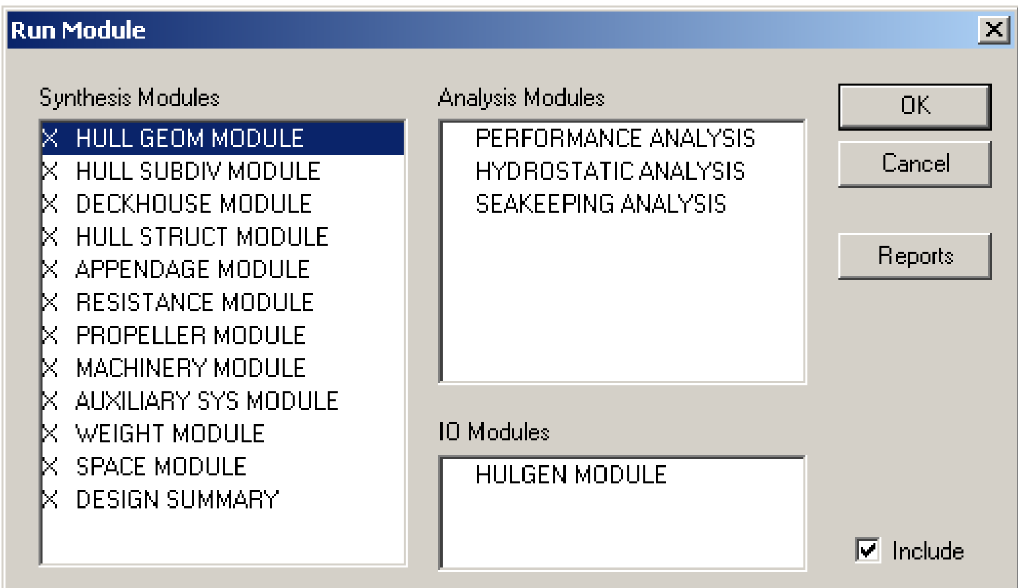
One of the defaulted values is the HULL FLARE ANGLE. This value will stay in the model unless it is changed later. In the above example, the angle was set at 0°. To change the angle from 0° to 10°, go into the Editor. After getting in the Editor, type “HULL FLARE ANGLE” in the parameter box and press the **Find** button. The HULL FLARE ANGLE will be highlighted in the tree view of the Editor:



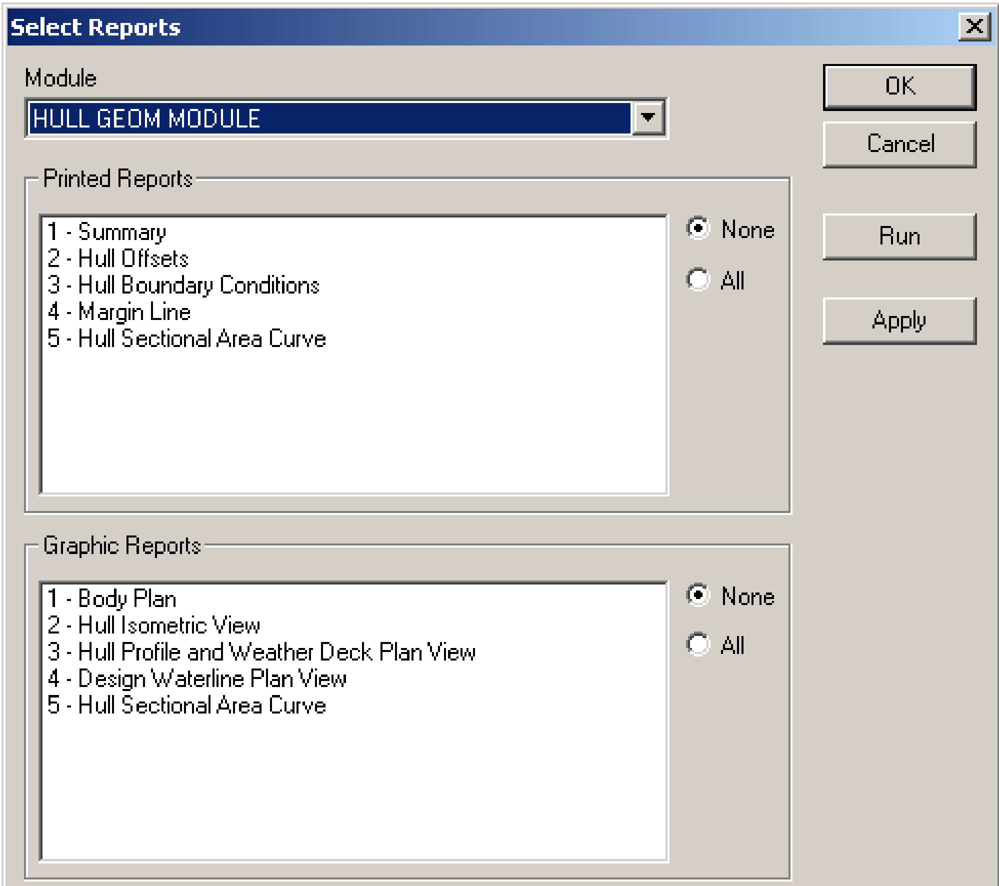
The Editor shows that the HULL FLARE ANGLE parameter is 0°. Change the value of the angle from 0° to 10°. Exit the Editor and save the results. Run the module as before and look at the results. Although you have successfully run the module, you have changed a parameter's value after the last run of the module. By running the module again, the change was incorporated into the hull design.

This is a good point to modify your ship after the first run of the Hull Geometry Module. Use the command **Ship⇒Modify** from the menu.

If you want to look at the printed and graphic reports generated by this module, click **Module⇒ Run**. The dialog box will reappear as it did when you first ran the module:



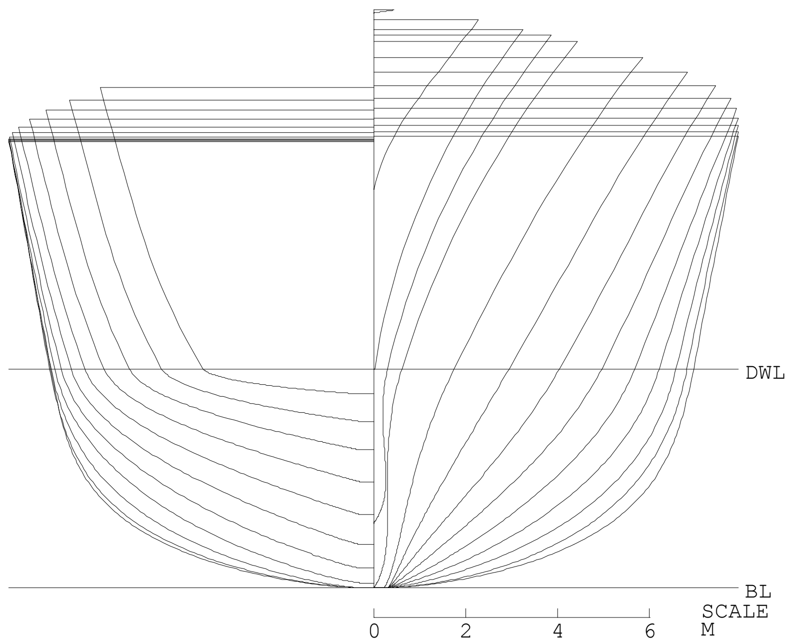
This time, click **Reports** and a new dialog box will appear:



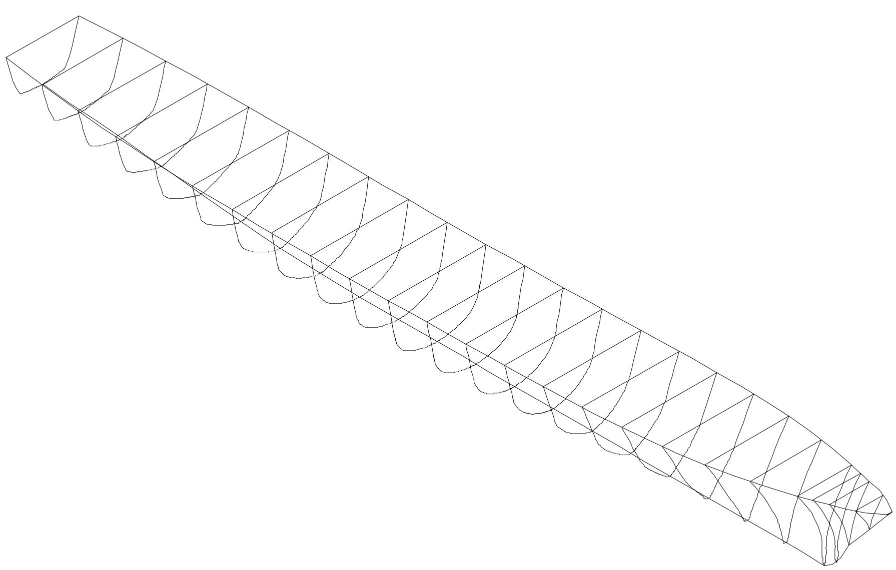
Select as many as you like. By holding down the Control key while clicking on the desired reports, you will be able to select more than one. After selecting the reports, press **RUN**. This will run the module and the first graphic report (if you select one) will appear in the Graphics Reports window. **If you selected more than one graphic report, you need to click the mouse button (or hit any key) to proceed to the next report or to get back to the "READY" status (shown in the lower right of the status bar) vice "GRAPHICS" status**. Using the Print command located in the File menu of the menu bar will print the contents of whichever window is active. **Note**: The PRINTED REPORTS and MESSAGES windows do not clear themselves. Later in this tutorial, if you print the contents of the PRINTED REPORTS window, you will print everything that has been sent to that window during the entire ASSET session--not just the reports you have selected for the current module with which you are working. To avoid this, *clear the window* before generating any new printed reports. Do this by clicking on the title bar to ensure the window is active, select **Edit** from the menu bar, followed by the

Select⇒All, then select the **Clear** command from the Edit menu. Following are the body plan and the hull isometric view graphic reports, and the summary printed report.

ASSET/MONOSC V4.6.0 - HULL GEOM MODULE - 10/16/2000 15:19. 8
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - BODY PLAN



ASSET/MONOSC V4.6.0 - HULL GEOM MODULE - 10/16/2000 15:19. 8
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 2 - HULL ISOMETRIC VIEW

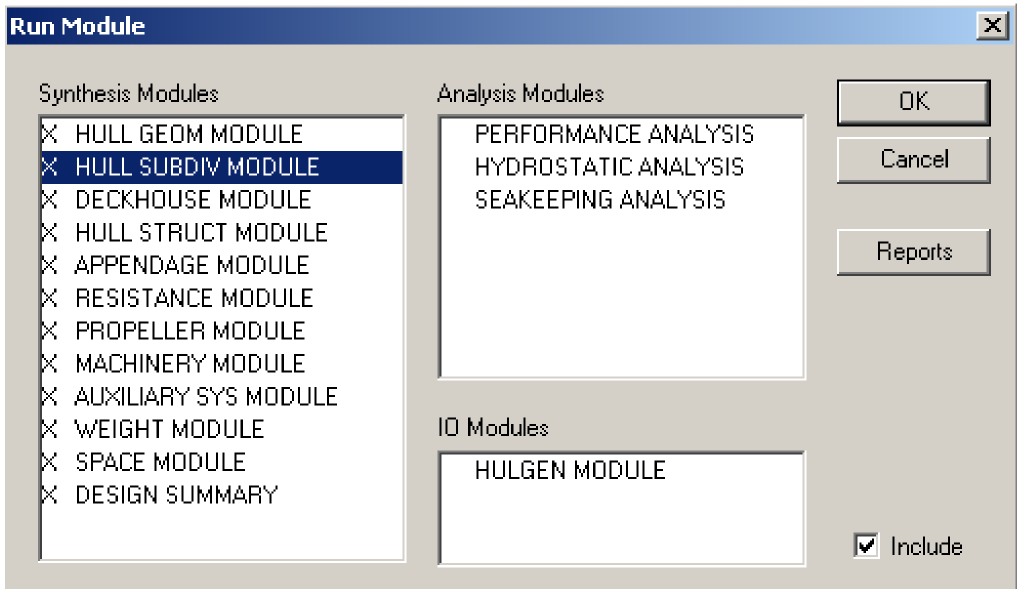


```
      ASSET/MONOSC V4.6.0 - HULL GEOM MODULE - 10/16/2000 15:21.44
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO.  1 - HULL GEOMETRY SUMMARY

HULL OFFSETS IND-GENERATE             MIN BEAM, M                 9.14
HULL DIM IND-B+D+T                    MAX BEAM, M                32.19
MARGIN LINE IND-CALC                  HULL FLARE ANGLE, DEG      10.00
HULL STA IND-OPTIMUM                  FORWARD BULWARK, M          1.22
HULL BC IND-DDG 51
FAST SHIP PARENT IND-

                  HULL PRINCIPAL DIMENSIONS (ON DWL)
                  ==================================
LBP, M                      131.00    PRISMATIC COEF             0.578
HULL LOA, M                 137.62    MAX SECTION COEF           0.802
BEAM, M                      14.01    WATERPLANE COEF            0.771
BEAM @ WEATHER DECK, M       15.78    LCB/LBP                    0.506
DRAFT, M                      4.76    HALF SIDING WIDTH, M        0.30

DEPTH STA 0, M               12.73    BOT RAKE, M                 0.00
DEPTH STA 3, M               11.08    RAISED DECK HT, M           0.00
DEPTH STA 10, M               9.79    RAISED DECK FWD LIM, STA
DEPTH STA 20, M              10.90    RAISED DECK AFT LIM, STA
FREEBOARD @ STA 3, M          7.55    BARE HULL DISPL, MTON    4150.01

STABILITY BEAM, M            14.01    AREA BEAM, M               13.10

      BARE HULL DATA ON LWL                 STABILITY DATA ON LWL
      =====================                 =====================
LGTH ON WL, M               131.00    KB, M                       2.94
BEAM, M                      14.01    BMT,  M                     4.33
DRAFT, M                      4.76    KG,  M                      5.87
FREEBOARD @ STA 3, M          7.55    FREE SURF COR, M            0.00
PRISMATIC COEF               0.578    SERV LIFE KG ALW, M         0.00
MAX SECTION COEF             0.802
WATERPLANE COEF              0.772    GMT, M                      1.40
WATERPLANE AREA, M2        1417.14    GML, M                    345.43
WETTED SURFACE, M2         1911.47    GMT/B AVAIL                0.100
                                      GMT/B REQ                  0.100
BARE HULL DISPL, MTON      4152.39
APPENDAGE DISPL, MTON        90.10
FULL LOAD WT, MTON         4242.48
```

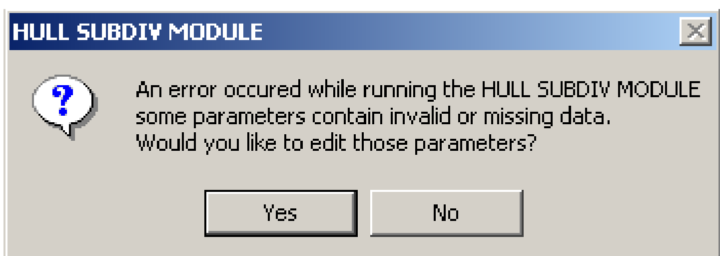
6.7 HULL SUBDIVISION MODULE

The next module in the sequence is Hull Subdivision. This module defines the internal hull subdivisions, including decks, platforms, transverse bulkheads, longitudinal bulkheads and inner bottoms.

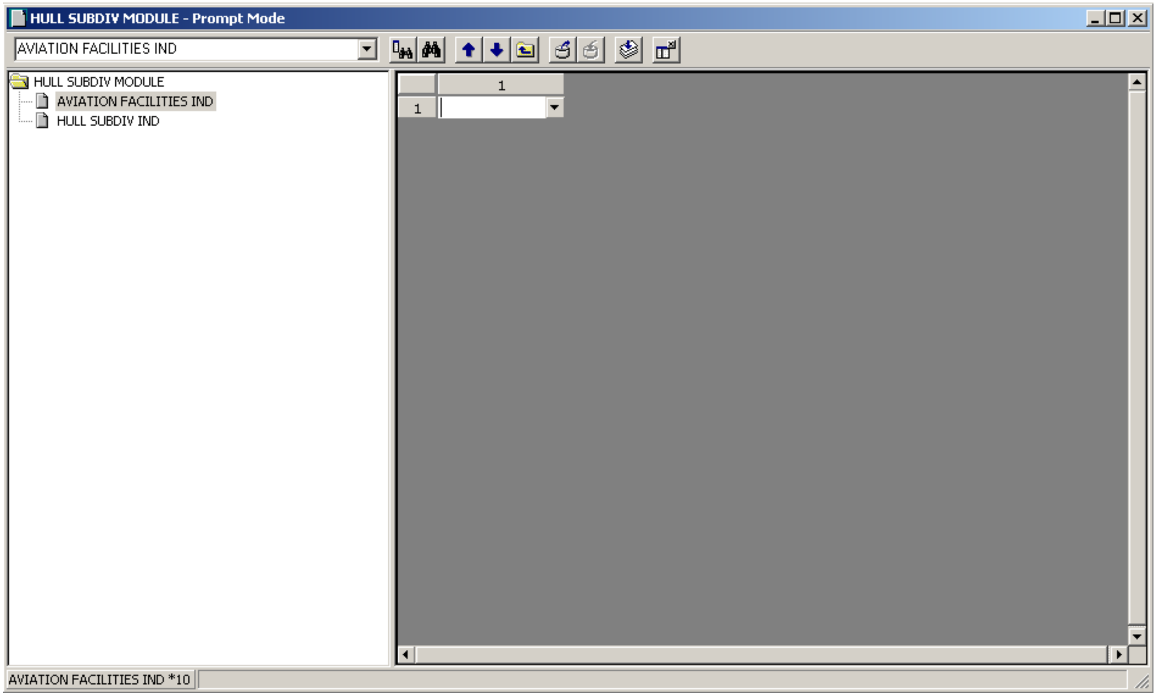
To begin, go to the Module menu and click **Module⇒Run**. The following dialog box appears:



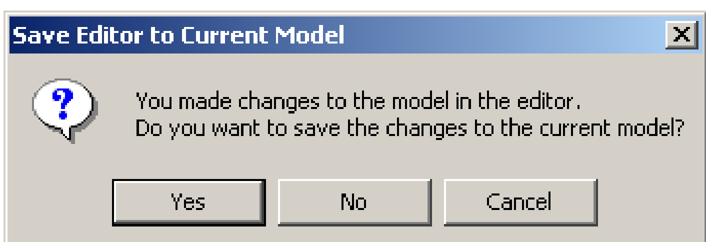
Highlight the **HULL SUBDIV MODULE** and click **OK** to continue with the program. ASSET will give the following message:



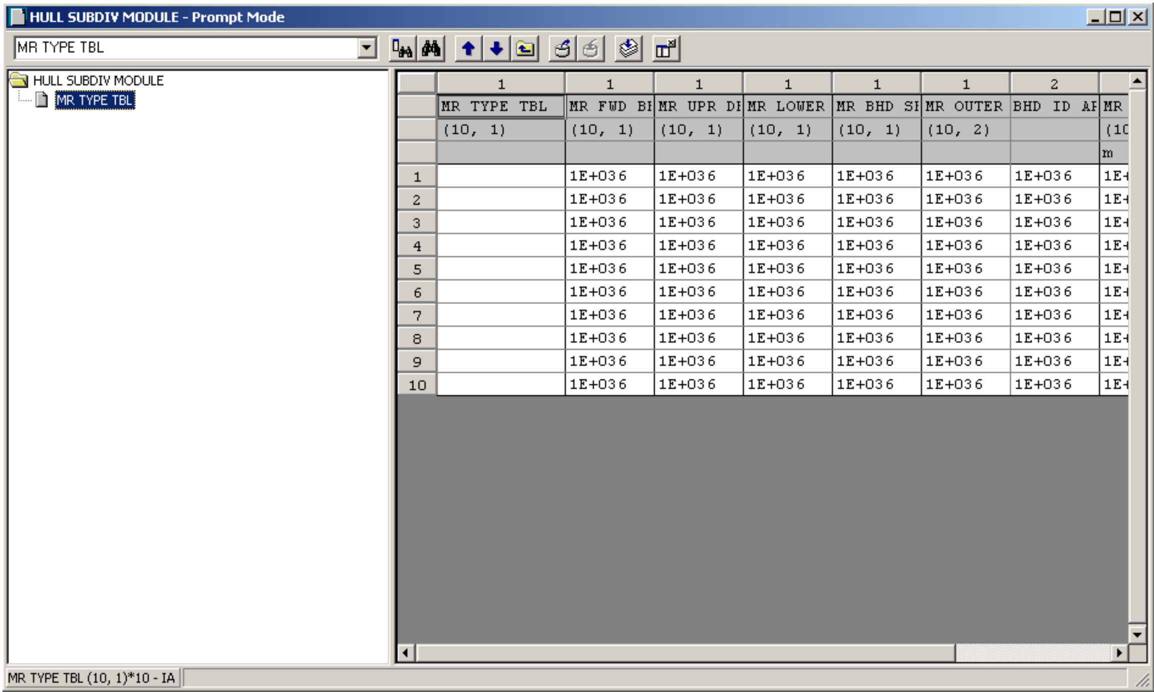
After clicking "Yes", ASSET will take you to the following dialog box:



ASSET is requesting you to enter information. Click on the arrow on the drop down cell to reveal the two options: **GIVEN** and **CALC**. For the HULL SUBDIV IND, choose **CALC**. For the AVIATION FACILITIES IND, choose **MINOR AVN**. After entering the choices, this message will appear:

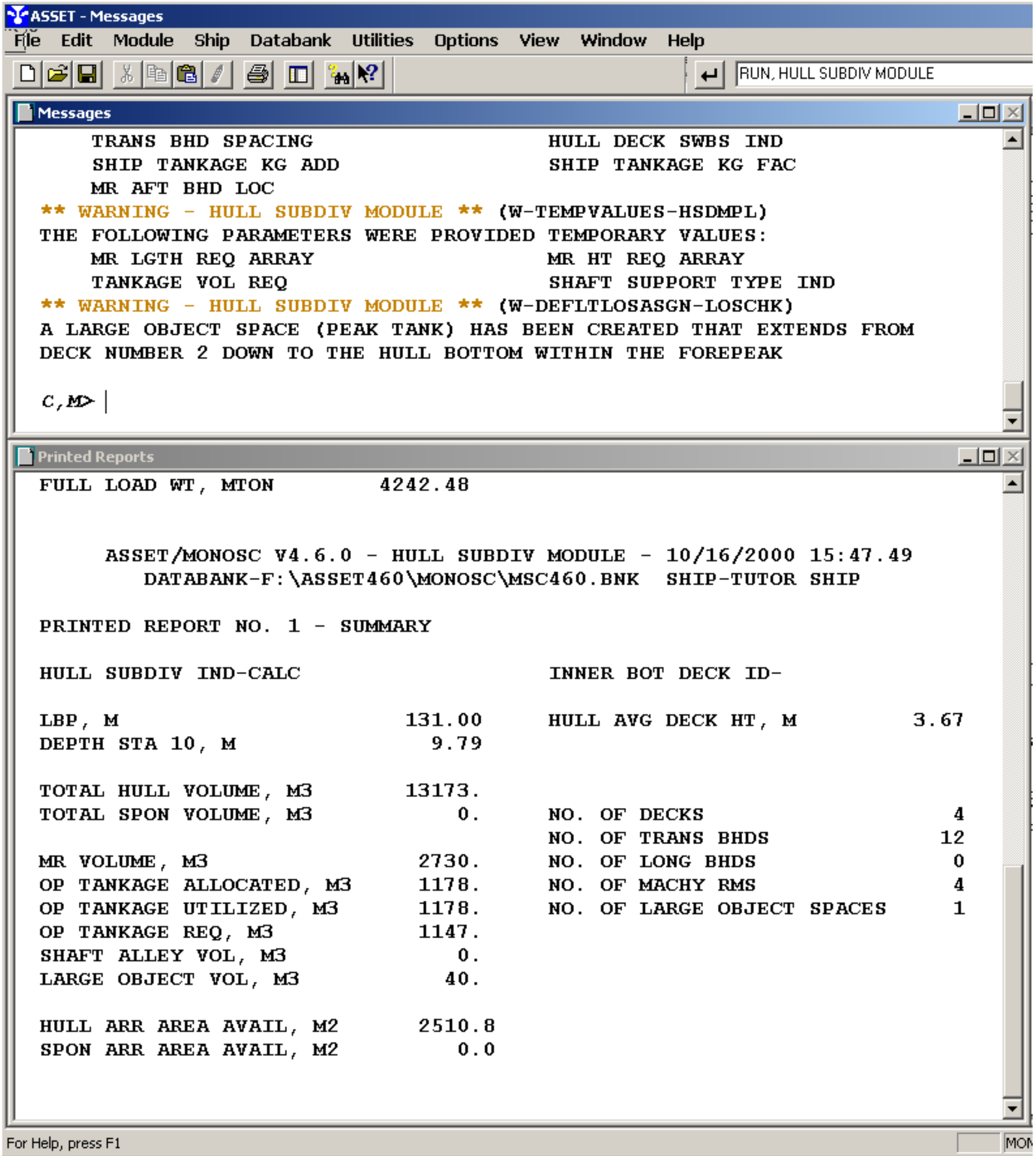


After selecting "Yes", ASSET will run the Hull Subdivision Module again. The error message that appeared at the beginning of the run will appear here. It asks whether you want to edit any missing or invalid data. After selecting "Yes", the Editor dialog box will open and request that you enter data for the Machinery Room Type Table (**MR TYP TBL**). Read the on-line help on this parameter (Click the right mouse button and select **What's This?**). The dialog box will look like this:



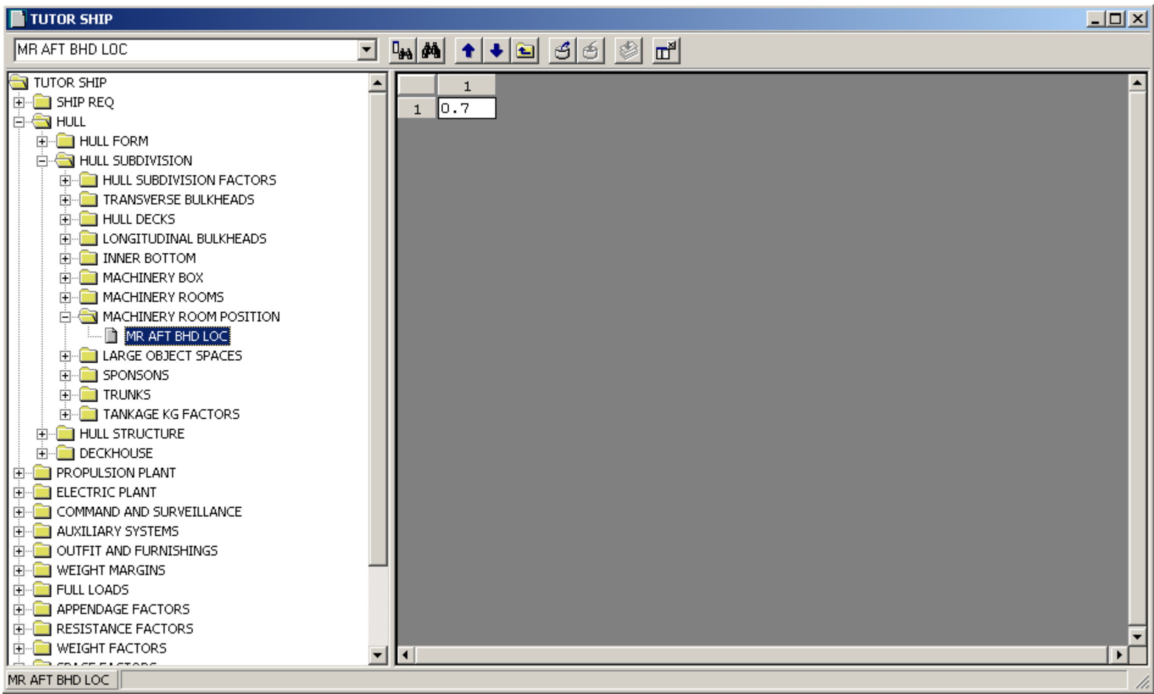
	1	1	1	1	1	1	2	
	MR TYPE TBL	MR FWD BH	MR UPR DI	MR LOWER	MR BHD SE	MR OUTER	BHD ID AF	MR
	(10, 1)	(10, 1)	(10, 1)	(10, 1)	(10, 1)	(10, 2)		(10
								m
1		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
2		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
3		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
4		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
5		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
6		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
7		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
8		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
9		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+
10		1E+036	1E+036	1E+036	1E+036	1E+036	1E+036	1E+

From the inboard profile, obtain the order in which the machinery rooms are arranged. Starting forward, there is an auxiliary machinery room (AMR), then a main machinery room (MMR), then a compartment followed by a main machinery room and an auxiliary machinery room. Therefore, in column 1, input the following data in the first four rows in the following order: **AMR-MMR-MMR-AMR**. Additional parameters are needed to complete the input this module needs to run the program. To define the compartment between the two MMRs, you need to set a value for the parameter Machinery Room Bulkhead Separation Array (MR BHD SEP ARRAY). This array is located in column 5 and should contain no data, as indicated by "1E+036". This means that ASSET will supply a default value of 1when this parameter is needed. The default may not be desired for a variety of reasons. Here, the inboard profile dictates that two bulkheads separate the main machinery rooms. You need to set this value. In the MR BHD SEP ARRAY column, enter the values **1, 2, 1**. Since the first separation—AMR-MMR--is one bulkhead, the first value in the array is **1**. The second separation—MMR-MMR—has two bulkheads; therefore, the second value in the array is **2**. The third separation is like the first. Click the **Run** button on the Editor dialog box and the Save Editor to Current Model dialog box will appear. After selecting "Yes", ASSET will run the Hull Subdivision Module. The Message and Printed Reports windows will look like this:

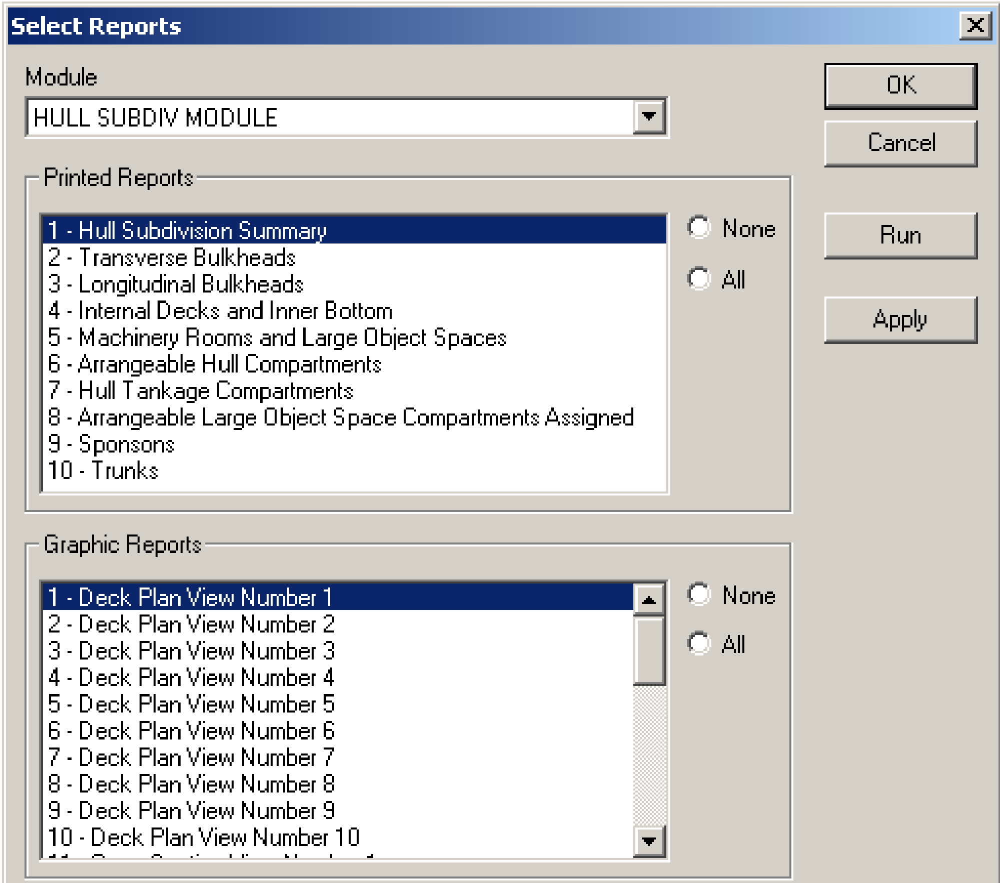


Notice the warning and model modifications. Look at the parameters that were provided default values. The MR AFT BHD LOC parameter sticks out as one that can be determined using the inboard profile. Use the on-line help for clarification of this parameter. ASSET defaults to **0.70** of L_{BP} but this parameter can be defined more accurately. Measuring off the inboard profile, the aft machinery room bulkhead lies at **0.81**. To change the MR AFT BHD LOC to **0.81**, go to the Edit menu and get into the

ASSET Editor. Type in the dialog box "MR AFT BHD LOC" and click the **Jump To** button. The MR AFT BHD LOC will be highlighted in the tree view of the Editor:

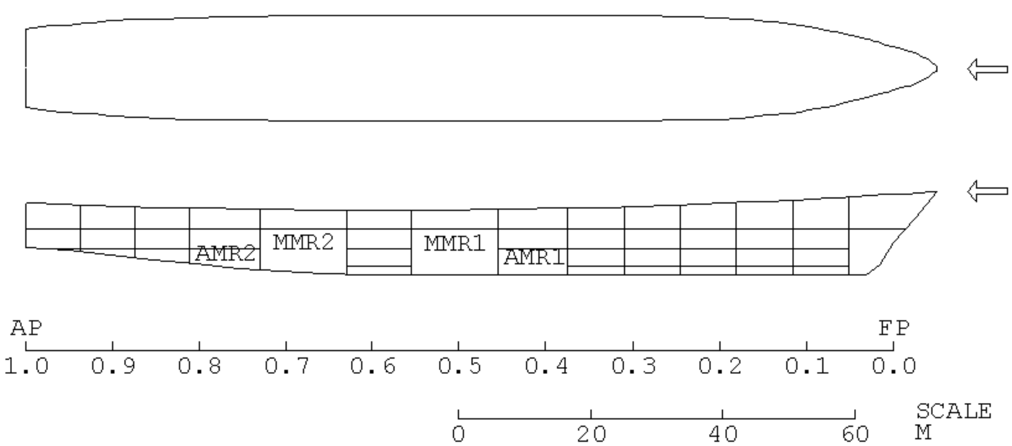


As stated earlier, the value for this parameter is **0.7**. Click on the cell to change it to **0.81**. Get out of the Edit Mode, and the Save Editor to Current Model dialog box will appear. After clicking "Yes", run the Hull Subdivision Module. The new value has been incorporated in the results. To see the reports that reflect the changes, select **Module⇒Run** then click the **Reports** button. The dialog box should look like this:



Choose from the Printed Reports list #1—Hull Subdivision Summary—and Graphic Report #1—Deck Plan View Number 1—to see the results of the change. After you click the **Run** button, ASSET will produce the reports as shown below. Save your ship by going to the Ship menu (**Ship⇒Modify**).

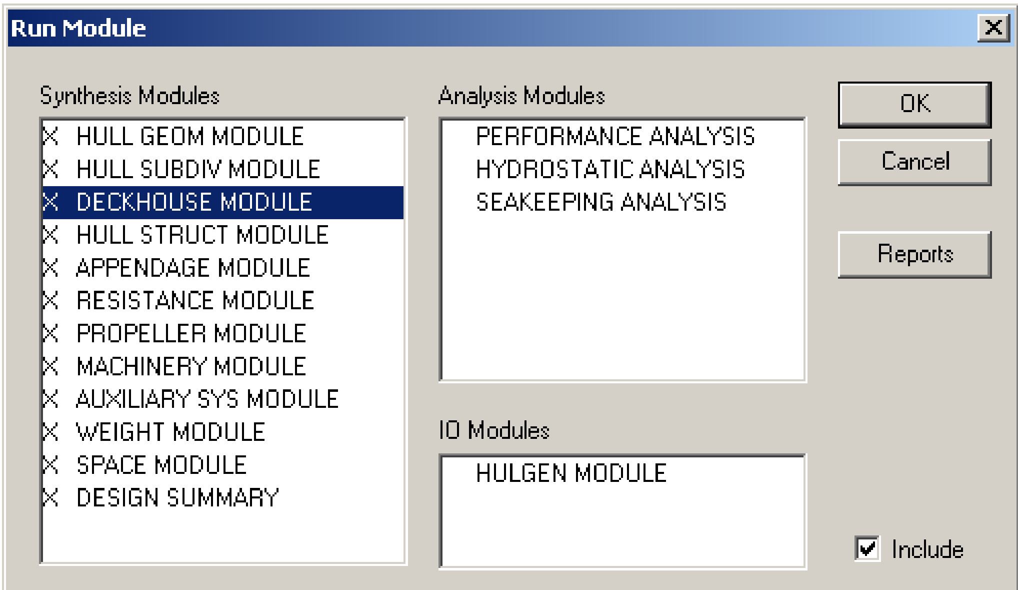
```
ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/17/2000  9: 5.23
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - HULL DECKS AND PLATFORMS
MAIN DECK
(DECK NO.  1)

DECK AREA, M2                 1948.2
TOTAL SHIP ARR AREA, M2       2565.6
TOTAL HULL VOLUME, M3         13180.
```



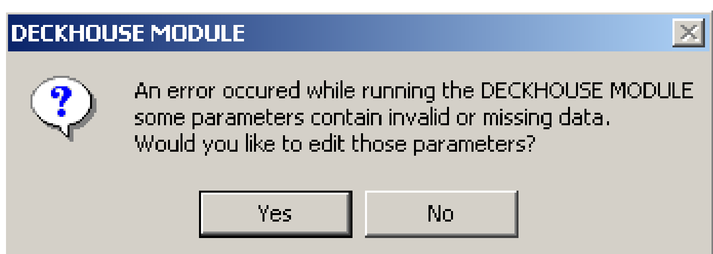

```
ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/17/2000  9: 7.18
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

HULL SUBDIV IND-CALC                     INNER BOT DECK ID-

LBP, M                      131.00       HULL AVG DECK HT, M         3.64
DEPTH STA 10, M               9.79

TOTAL HULL VOLUME, M3       13180.
TOTAL SPON VOLUME, M3           0.       NO. OF DECKS                   4
                                         NO. OF TRANS BHDS             13
MR VOLUME, M3                2642.       NO. OF LONG BHDS               0
OP TANKAGE ALLOCATED, M3     1154.       NO. OF MACHY RMS               4
OP TANKAGE UTILIZED, M3      1154.       NO. OF LARGE OBJECT SPACES     1
OP TANKAGE REQ, M3           1147.
SHAFT ALLEY VOL, M3             0.
LARGE OBJECT VOL, M3           40.

HULL ARR AREA AVAIL, M2      2565.6
SPON ARR AREA AVAIL, M2         0.0
```

6.8 DECKHOUSE MODULE

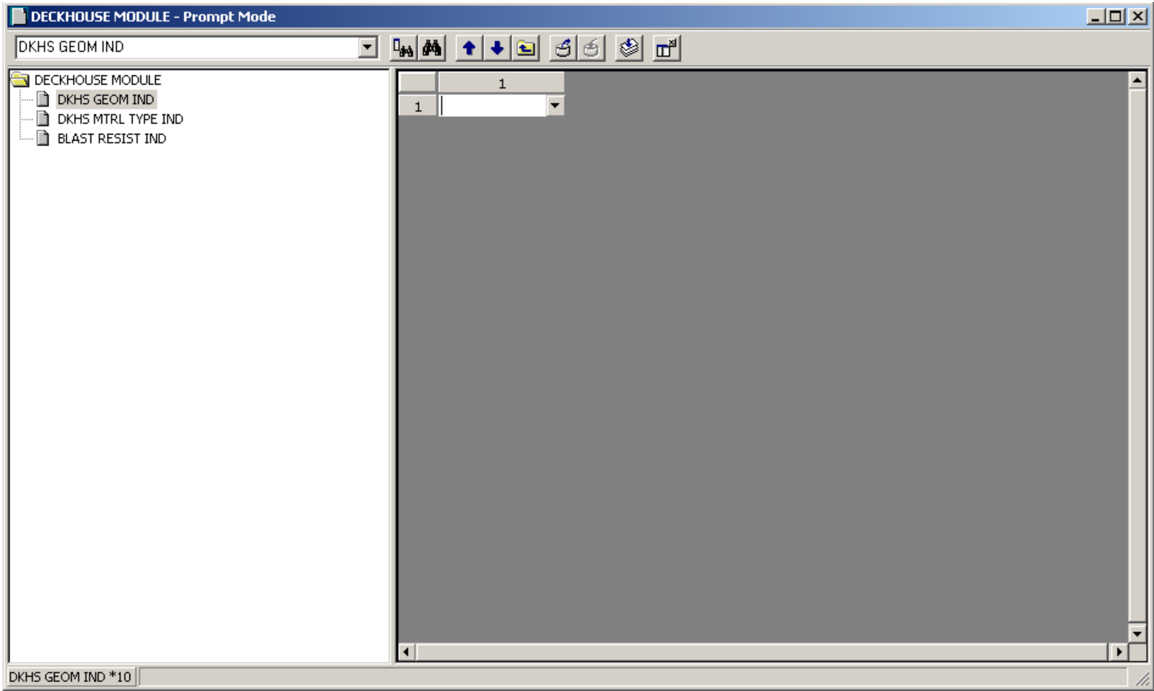
The Deckhouse module is the next module in the sequence. This module defines the geometry of the ship's deckhouse and calculates internal deckhouse area and deckhouse weight. To begin data entry, run the module. The following dialog box appears:



Select Deckhouse Module and click **OK.** The following dialog box appears:



After clicking "Yes", the following dialog box appears:



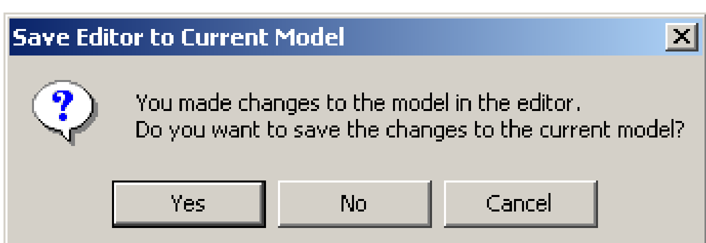
As expected, ASSET needs data to run the Deckhouse Module. Be sure to access the on-line help for a complete understanding of the following parameters. Input the following choices for each parameter:

DKHS GEOM IND: **GENERATE**

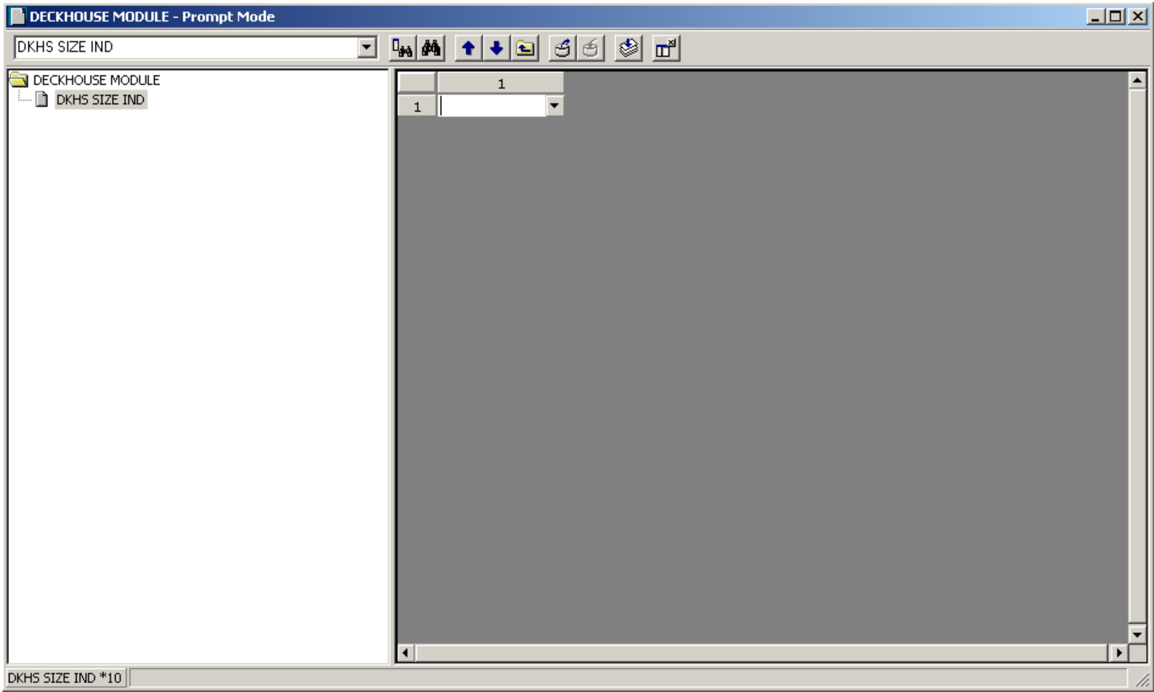
DKHS MTRL TYPE IND: **ALUMINUM**

BLAST RESIST IND: **3 PSI**

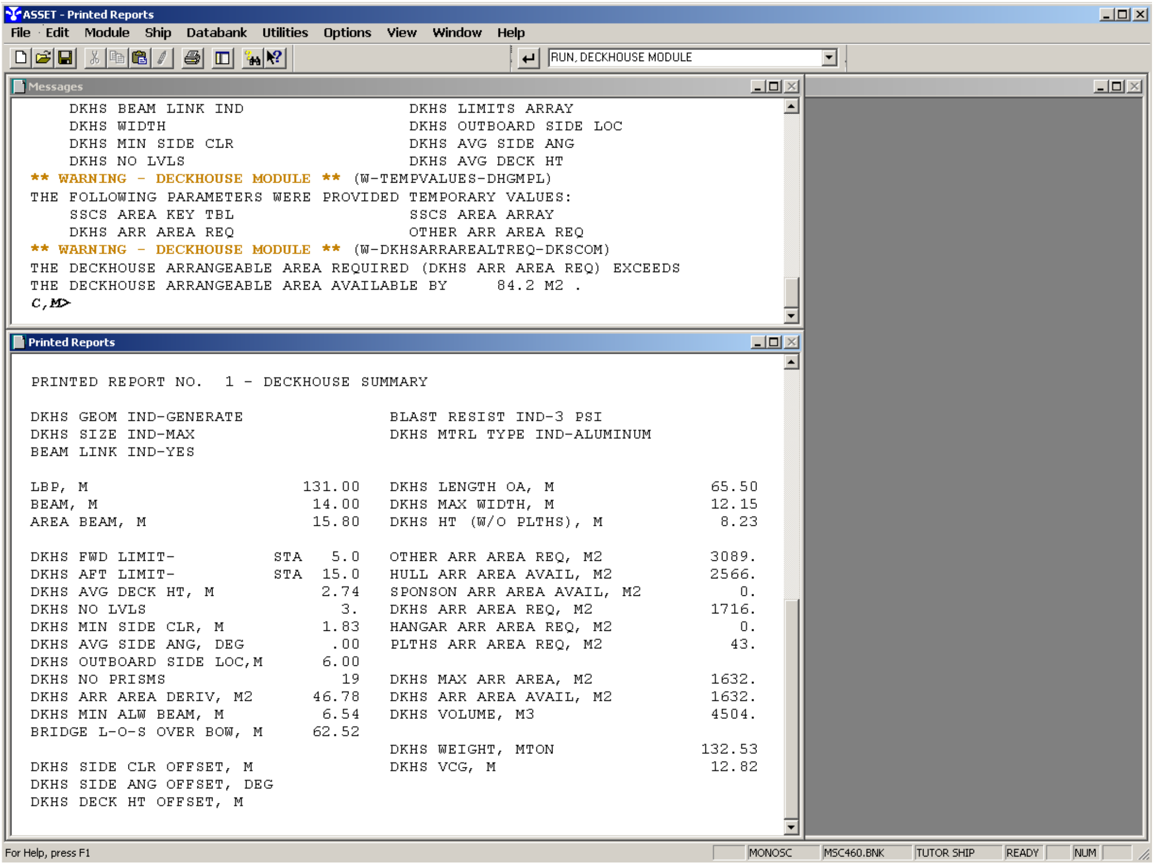
After inputting the data, the following dialog box appears:



After clicking "Yes", ASSET will run the Deckhouse Module. The error message dialog box will appear again because ASSET is requesting more data. After you click "Yes", the next dialog box will appear:

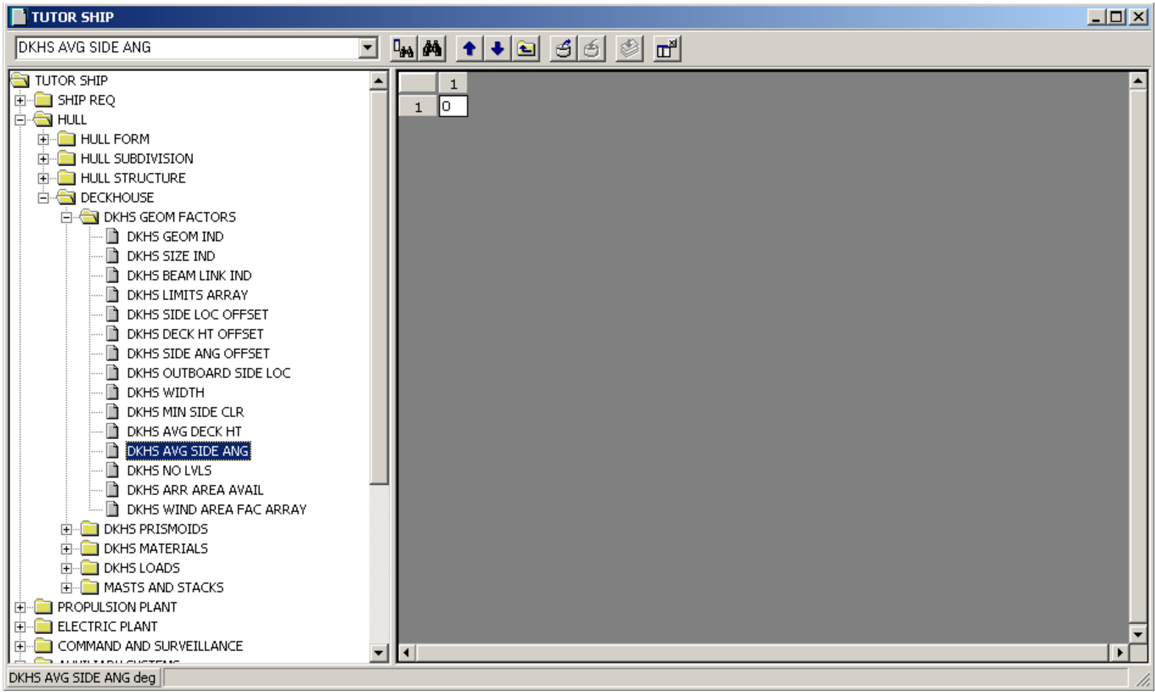


Choose **MAX** for the DKHS SIZE IND. Be sure to read the on-line help on this parameter. The Save Editor to Current Run dialog box will appear. After you click “Yes”, ASSET will run the Deckhouse Module again. The Message and Printed Reports windows will look like this:



Look at the warning messages and the parameters that were assigned default values. Notice the last warning. Although this might seem alarming, it really is not. You have not run the Space Module, so the space requirement is purely a guess.

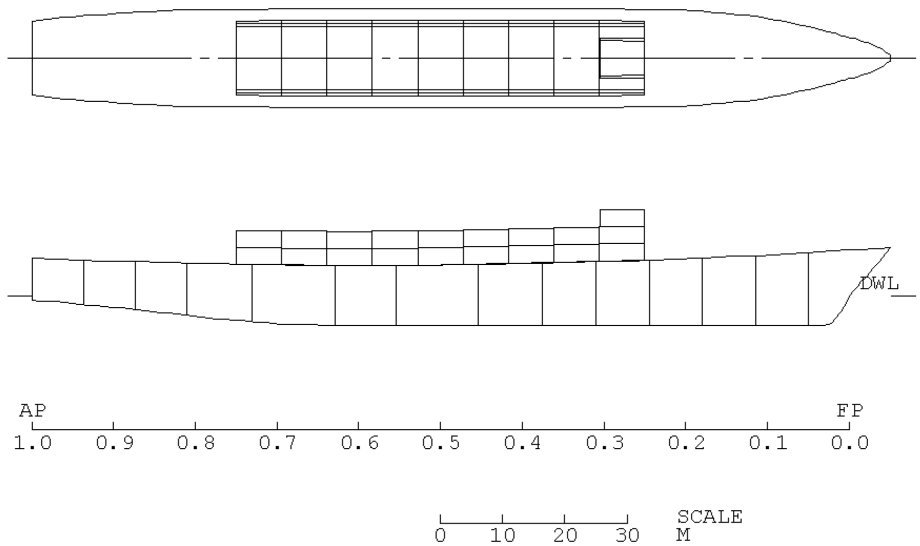
For this design, the deckhouse sides should be angled 10°. Since the DKHS AVG SIDE ANG parameter was given a default value, it is not set properly for this design. Set this parameter to 10° by getting into the Editor and typing “DKHS AVG SIDE ANG” in the parameter box. After you click the **Jump To** button, the DKHS AVG SIDE ANG parameter will appear:



After you have entered the new value, run the Deckhouse Module again to incorporate the design change.

You have completed entering data for the Deckhouse Module. The Deckhouse Summary Printed Report and Deckhouse Profile and Plan Views Graphic reports follow.

ASSET/MONOSC V4.6.0 - DECKHOUSE MODULE - 10/17/2000 9:53.11
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - DECKHOUSE PROFILE AND PLAN VIEWS



ASSET/MONOSC V4.6.0 - DECKHOUSE MODULE - 10/17/2000 9:54.26
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - DECKHOUSE SUMMARY

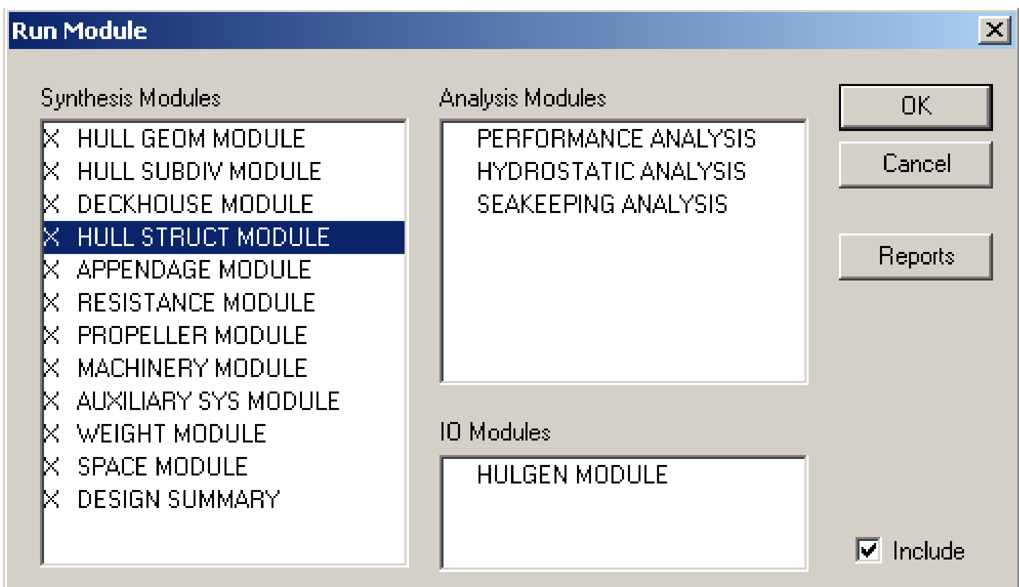
DKHS GEOM IND-GENERATE		BLAST RESIST IND-3 PSI	
DKHS SIZE IND-MAX		DKHS MTRL TYPE IND-ALUMINUM	
BEAM LINK IND-YES			
LBP, M	131.00	DKHS LENGTH OA, M	65.50
BEAM, M	14.00	DKHS MAX WIDTH, M	12.15
AREA BEAM, M	16.16	DKHS HT (W/O PLTHS), M	8.23
DKHS FWD LIMIT-	STA 5.0	OTHER ARR AREA REQ, M2	3089.
DKHS AFT LIMIT-	STA 15.0	HULL ARR AREA AVAIL, M2	2566.
DKHS AVG DECK HT, M	2.74	SPONSON ARR AREA AVAIL, M2	0.
DKHS NO LVLS	3.	DKHS ARR AREA REQ, M2	1716.
DKHS MIN SIDE CLR, M	1.83	HANGAR ARR AREA REQ, M2	0.
DKHS AVG SIDE ANG, DEG	10.00	PLTHS ARR AREA REQ, M2	43.
DKHS OUTBOARD SIDE LOC,M	6.00		
DKHS NO PRISMS	19	DKHS MAX ARR AREA, M2	1505.
DKHS ARR AREA DERIV, M2	47.48	DKHS ARR AREA AVAIL, M2	1505.
DKHS MIN ALW BEAM, M	9.13	DKHS VOLUME, M3	4156.
BRIDGE L-O-S OVER BOW, M	62.52		
		DKHS WEIGHT, MTON	122.27
DKHS SIDE CLR OFFSET, M		DKHS VCG, M	12.75
DKHS SIDE ANG OFFSET, DEG			
DKHS DECK HT OFFSET, M			

6.9 HULL STRUCTURE MODULE

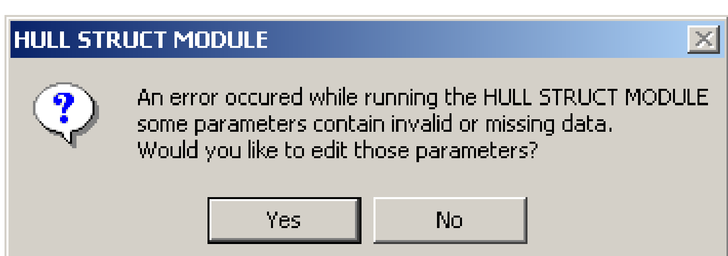
This module calculates hull structural scantlings and hull structural weight data for the ship defined in the current model. To begin data entry, run the Hull Structure Module. You may get the following error message:

```
** FATAL ERROR - HULL STRUCT MODULE ** (E-HSDDATINVALID-HSTMPL)
THE HULL SUBDIV MODULE MUST BE RUN BEFORE RUNNING THE HULL STRUCT MODULE
```

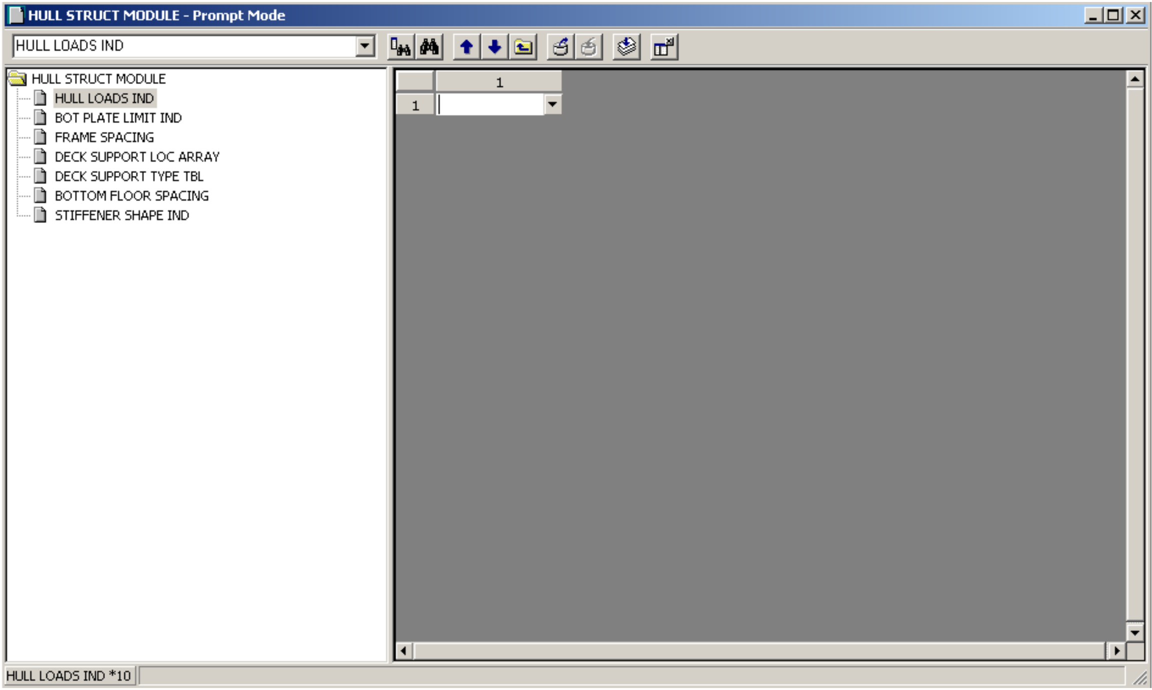
You may get this message because the Hull Structure Module wants to ensure that the information that was generated in the Hull Subdivision Module is up-to-date. Run the Hull Subdivision Module again (if you have saved this module the first time you ran it, it will only take a few seconds to do). After running the Hull Subdivision Module, go to the **Module⇒Run.** The following dialog box appears:



Select HULL STRUCT MODULE and click **OK**. The following dialog box appears:



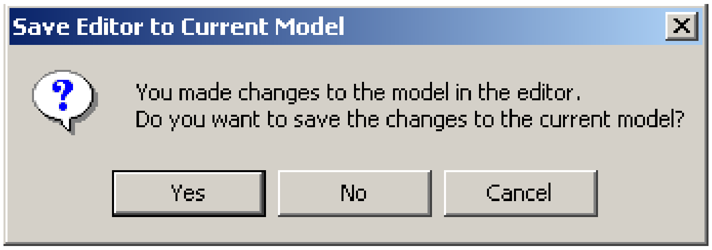
After clicking "Yes", the following dialog box appears:



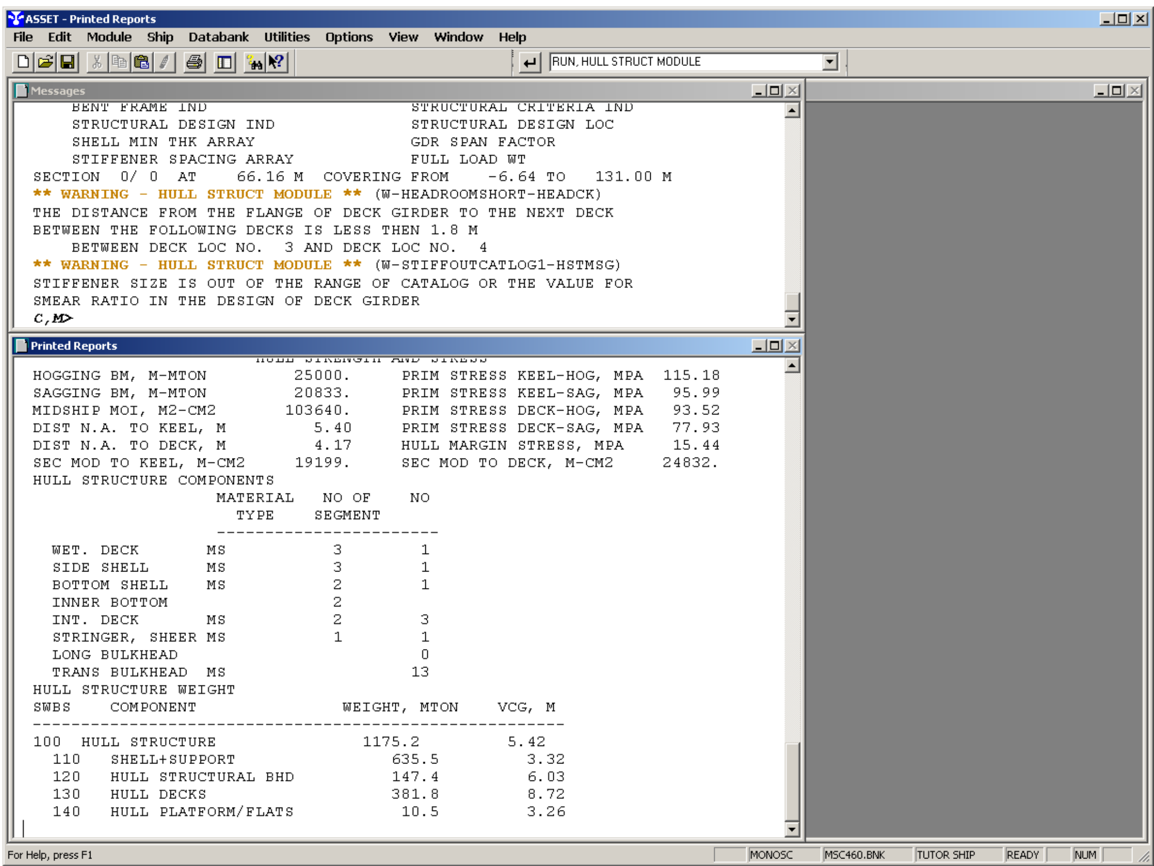
As usual, check the on-line help for parameter definitions. Select **CALC** for the HULL LOADS IND. This follows the plan to let ASSET calculate as much as possible. Enter the other parameter values. Be sure to access the on-line help for a complete understanding of the following parameters.

BOT PLATE LIMIT IND = **CALC**
FRAME SPACING = **2.44m**
DECK SUPPORT LOC ARRAY = **0.35** (Row 1)
DECK SUPPORT TYPE TABLE = **GIRDER** (Row 1)
BOTTOM FLOOR SPACING = **5m**
STIFFENER SHAPE IND = **CALC**

At this point, the Save Editor to Current Model dialog box appears. If it does not, click the **RUN** button on the Editor and it will appear.

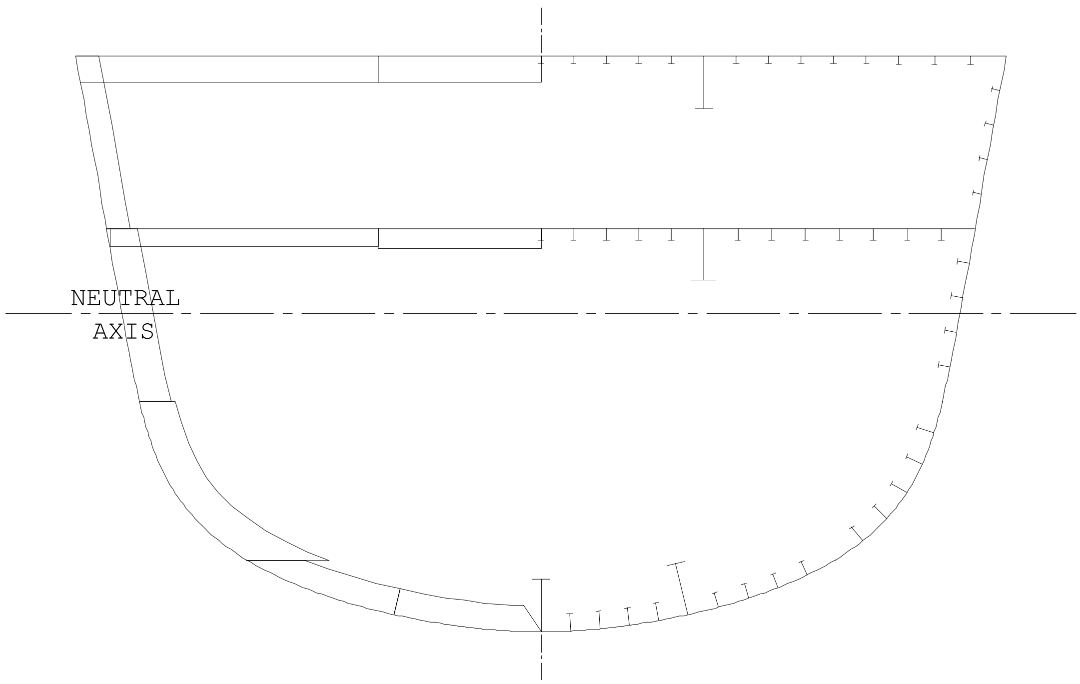


After clicking "Yes", ASSET will run the Hull Structure Module again. The Message and Printed Results windows will look like this:



Everything seems OK for now. The first run of the Hull Structure Module is complete. If you look at the Hull Structure Summary printed report and Midship Section graphic report, you will see this:

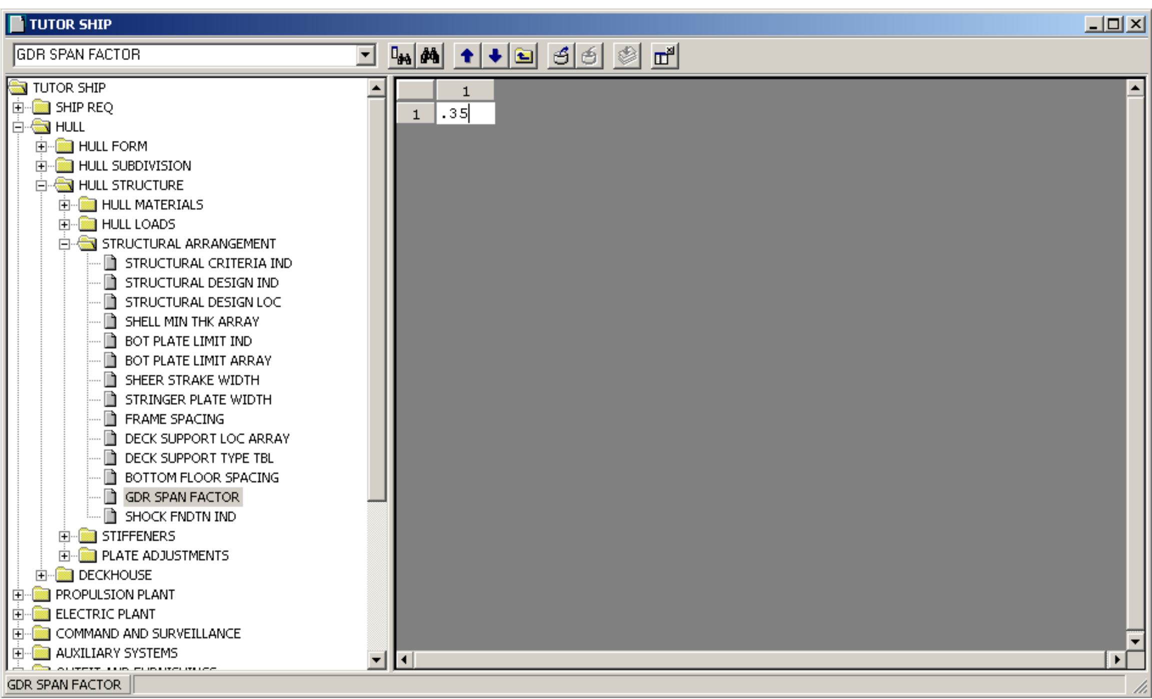
```
ASSET/MONOSC V4.6.0 - HULL STRUCT MODULE - 10/17/2000 10: 7.59
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - SECTION AT THE STRUCTURAL DESIGN LOCATION
```




```
     ASSET/MONOSC V4.6.0 - HULL STRUCT MODULE - 10/17/2000 10: 8. 9
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

STRUCTURAL DESIGN IND-SINGLE          STRUCTURAL DESIGN LOC-   0.500
                                      ACTUAL DESIGN LOC-   0.505
INNER BOT IND-      NONE              HULL LOADS IND-CALC
STIFFENER SHAPE IND-CALC

---------------------- HULL STRENGTH AND STRESS ----------------------
HOGGING BM, M-MTON         25000.     PRIM STRESS KEEL-HOG, MPA  115.18
SAGGING BM, M-MTON         20833.     PRIM STRESS KEEL-SAG, MPA   95.99
MIDSHIP MOI, M2-CM2       103640.     PRIM STRESS DECK-HOG, MPA   93.52
DIST N.A. TO KEEL, M         5.40     PRIM STRESS DECK-SAG, MPA   77.93
DIST N.A. TO DECK, M         4.17     HULL MARGIN STRESS, MPA     15.44
SEC MOD TO KEEL, M-CM2     19199.     SEC MOD TO DECK, M-CM2     24832.
HULL STRUCTURE COMPONENTS
                   MATERIAL   NO OF    NO
                     TYPE    SEGMENT
                   ----------------------
  WET. DECK       MS           3        1
  SIDE SHELL      MS           3        1
  BOTTOM SHELL    MS           2        1
  INNER BOTTOM                 2
  INT. DECK       MS           2        3
  STRINGER, SHEER MS           1        1
  LONG BULKHEAD                         0
  TRANS BULKHEAD  MS                   13
```

```
HULL STRUCTURE WEIGHT
SWBS    COMPONENT                     WEIGHT, MTON    VCG, M
-------------------------------------------------------
100  HULL STRUCTURE                     1175.2         5.42
  110   SHELL+SUPPORT                      635.5          3.32
  120   HULL STRUCTURAL BHD                147.4          6.03
  130   HULL DECKS                         381.8          8.72
  140   HULL PLATFORM/FLATS                 10.5          3.26
```

In the graphic, the longitudinal girders supporting each deck appear to be larger than normal. ASSET has defaulted the GDR SPAN FACTOR to a value of 0.7. However, 0.35 is appropriate for a configuration where the longitudinal girders are only supported by a stanchion midway between the transverse bulkheads (a common configuration). This will significantly reduce the required size of the girders. Changing the GDR SPAN FACTOR to 0.35 will reflect the use of stanchions. To do this, go into the Editor (**Edit⇒Open Editor**) and type "GDR SPAN FACTOR" in the parameter box. Click the **Jump To** button, and the parameter will appear on the edit tree:

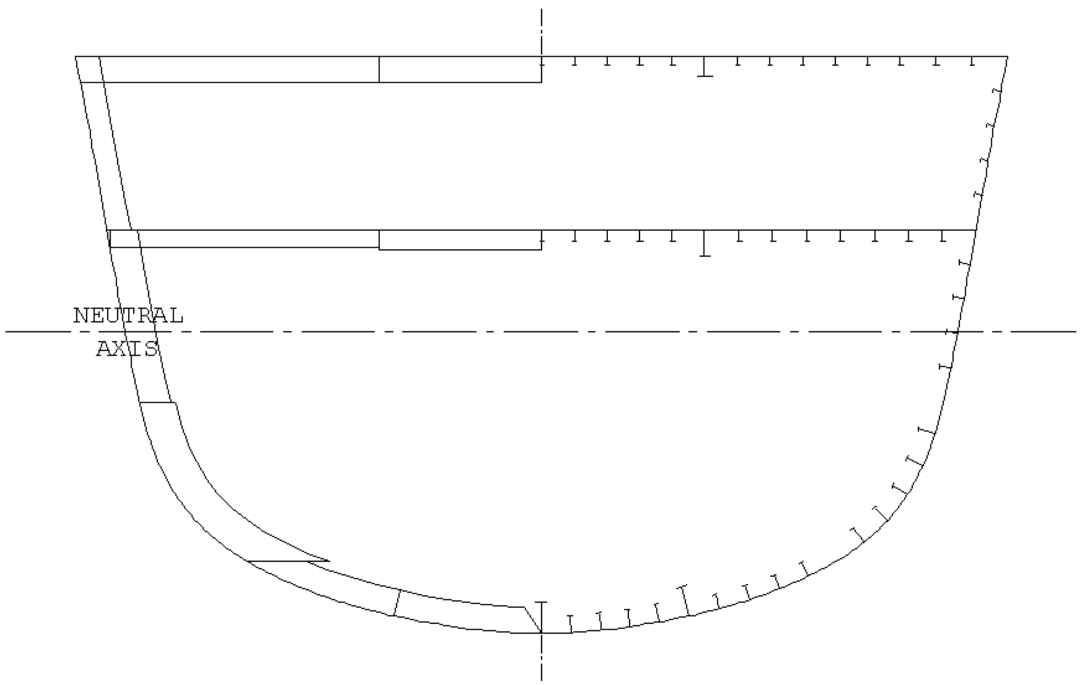


Change the following parameters:

GDR SPAN FACTOR: from **0.7** to **0.35**

After changing this parameter, exit the Editor and save the changes. Run the Hull Structure Module. The Midship Section Graphic and Summary Printed Reports look like this:

```
ASSET/MONOSC V4.6.0 - HULL STRUCT MODULE - 10/17/2000 10:25.14
  DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - SECTION AT THE STRUCTURAL DESIGN LOCATION
```




```
     ASSET/MONOSC V4.6.0 - HULL STRUCT MODULE - 10/17/2000 10:26.11
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO. 1 - SUMMARY

 STRUCTURAL DESIGN IND-SINGLE          STRUCTURAL DESIGN LOC-   0.500
                                       ACTUAL DESIGN LOC-   0.505
 INNER BOT IND-      NONE              HULL LOADS IND-CALC
 STIFFENER SHAPE IND-CALC

 ---------------------- HULL STRENGTH AND STRESS ----------------------
 HOGGING BM, M-MTON         25000.     PRIM STRESS KEEL-HOG, MPA  113.90
 SAGGING BM, M-MTON         20833.     PRIM STRESS KEEL-SAG, MPA   94.92
 MIDSHIP MOI, M2-CM2        91508.     PRIM STRESS DECK-HOG, MPA  103.65
 DIST N.A. TO KEEL, M         5.12     PRIM STRESS DECK-SAG, MPA   86.38
 DIST N.A. TO DECK, M         4.66     HULL MARGIN STRESS, MPA     15.44
 SEC MOD TO KEEL, M-CM2     17869.     SEC MOD TO DECK, M-CM2     19636.
 HULL STRUCTURE COMPONENTS
                   MATERIAL   NO OF    NO
```

```
                     TYPE    SEGMENT
                   -----------------------
  WET. DECK       MS           3        1
  SIDE SHELL      MS           3        1
  BOTTOM SHELL    MS           2        1
  INNER BOTTOM                 2
  INT. DECK       MS           2        3
  STRINGER, SHEER MS           1        1
  LONG BULKHEAD                         0
  TRANS BULKHEAD  MS                   13
HULL STRUCTURE WEIGHT
SWBS    COMPONENT                WEIGHT, MTON    VCG, M
-------------------------------------------------------
100  HULL STRUCTURE                1054.7         5.78
  110   SHELL+SUPPORT                 544.9         3.83
  120   HULL STRUCTURAL BHD           147.8         6.02
  130   HULL DECKS                    351.5         8.77
  140   HULL PLATFORM/FLATS            10.5         3.26
```

In the graphic, the structure between the lowest deck and the hull bottom appears to have interferences between several of the stiffeners. This is because ASSET does not recognize that this should be an inner bottom structure when the HULL SUBDIV IND is set to **CALC**. We will change this later in the design process.

ASSET has set default values for several parameters that control the structural design process and output. If you scroll back in the Messages window, you will see the list of defaulted parameters. As a minimum, review the definitions and default values of the following:

HULL MTRL TYPE TBL
STRUCTURAL DESIGN IND
STRUCTURAL SESIGN LOC

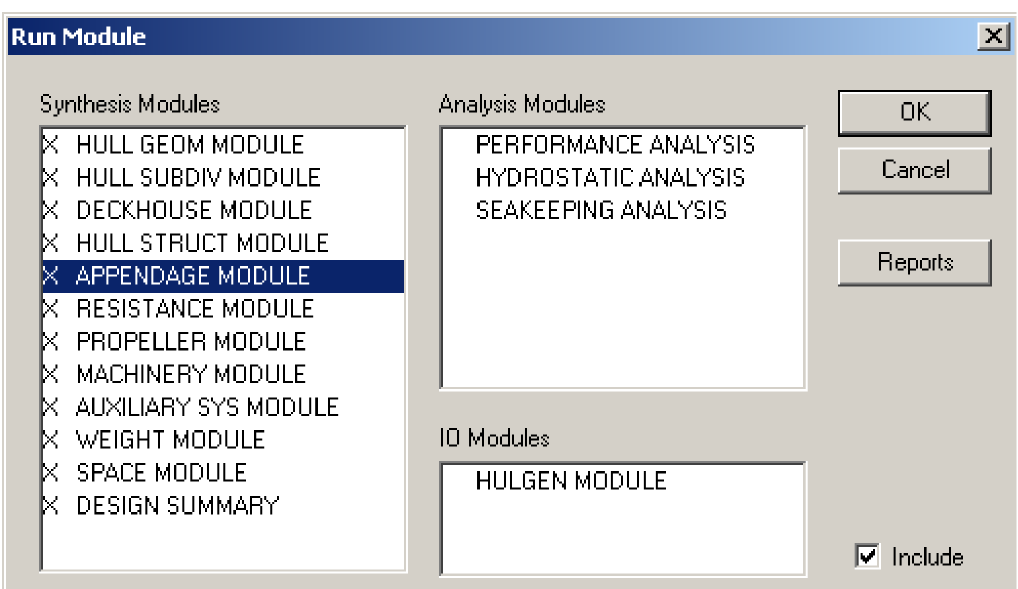
The STRUCTURAL DESIGN IND controls how many sections are designed through the length of the hull. This parameter has been defaulted to SINGLE and the STRUCTURAL DESIGN LOC has been defaulted to **0.5**. This combination result in the Hull Structures Module designing one section at amidships (0.5 LBP) and assuming the scantlings at this section extend throughout the length of the hull for weight estimates. When the STRUCTURAL DESIGN IND is set to **ALL** multiple sections will be designed one between each pair of transverse bulkheads. The **ALL** option will always give a more accurate weight estimate. The **SINGLE** option should only be used when a particularly slow CPU dictates.

With the STRUCTURAL DESIGN IND set to **ALL**, make several runs of the Hull Structural Module with the STRUCTURAL DESIGN LOC set to different values. Review the graphics reports and some of the printed reports to see the range of data available. Leave the STRUCTURAL DESIGN IND to **ALL**.

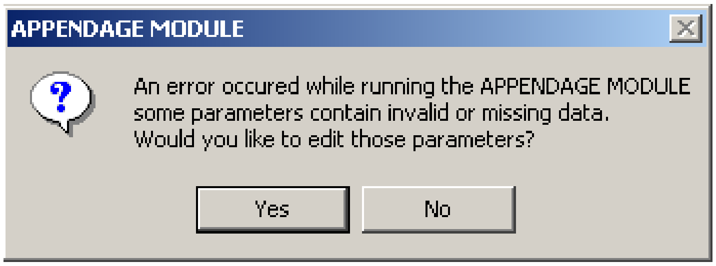
Save your ship by going to the Ship menu, (**Ship⇒ Modify)** and you are ready to go to the next module.

6.10 APPENDAGE MODULE

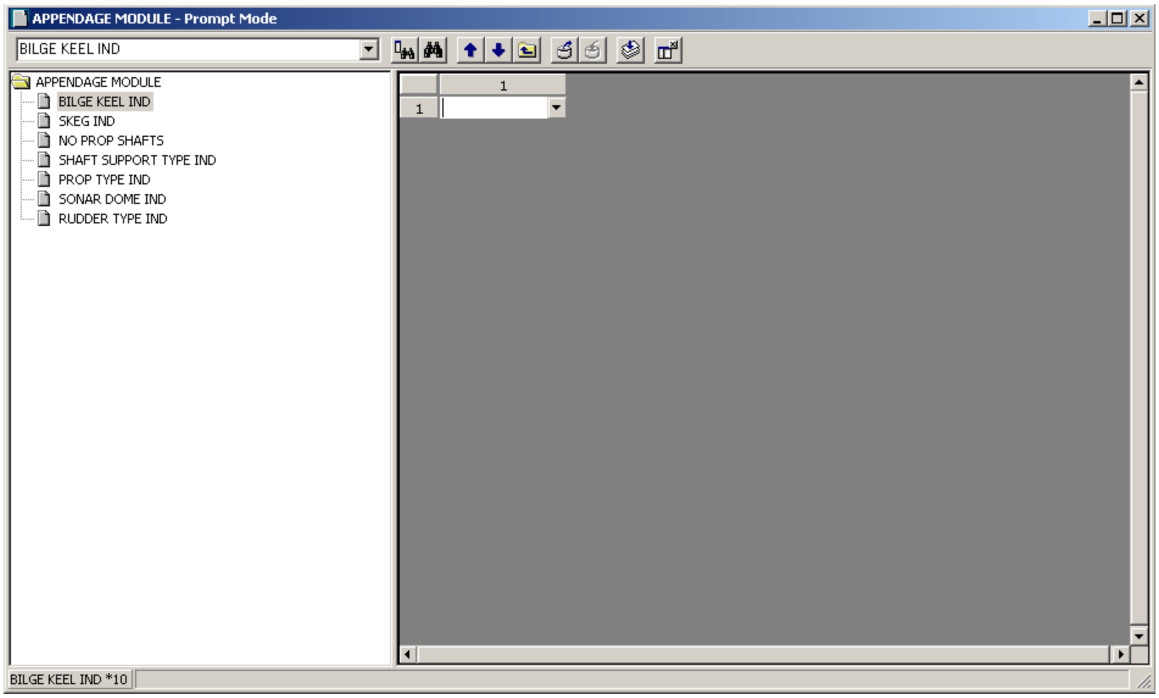
This module defines the geometry of hull appendages (except propulsion-related appendages) and computes their displacements. Your design has bilge keels, a skeg, an open strut shaft support, two controllable pitch propellers and a sonar dome. Use FRIGATE's data for details pertaining to the sonar dome (displacement and CB position). After selecting **Run** from the Module menu, you will see this dialog box:



After selecting the Appendage Module, you will get the following error message:



After clicking "Yes", you will come to the Appendage Module Edit Prompt Screen. It should look something like this:



Enter the following information for the parameters:

BILGE KEEL IND: **PRESENT**

SKEG IND: **PRESENT**

NO PROP SHAFTS: **2**

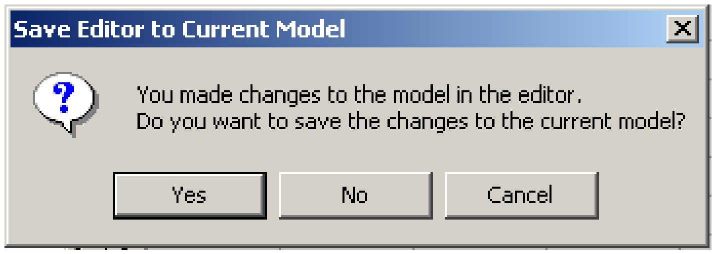
SHAFT SUPPORT TYPE IND: **OPEN STRUT**

PROP TYPE IND: **CP**

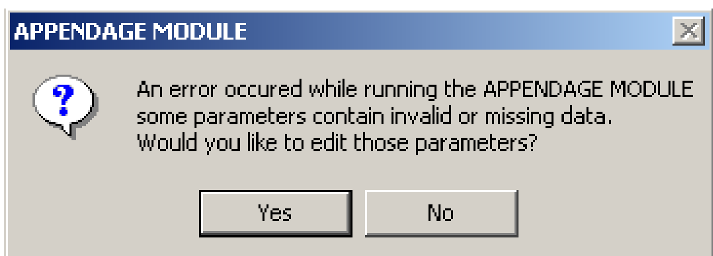
SONAR DOME IND: **PRESENT**

RUDDER TYPE IND: **SPADE**

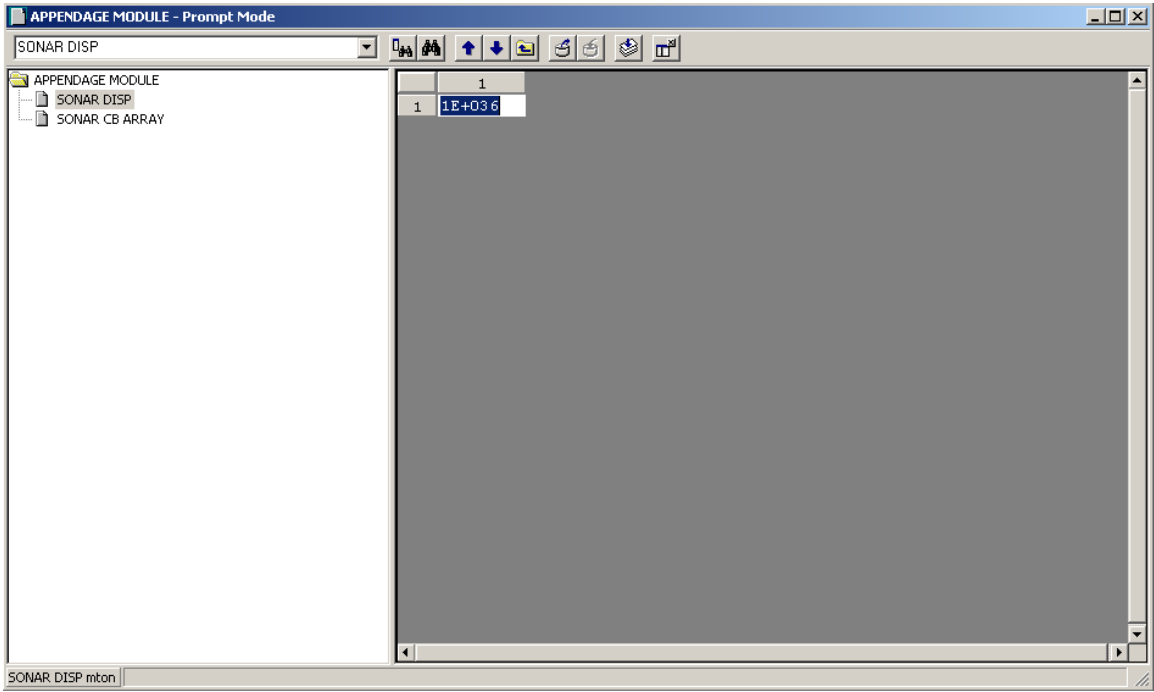
After entering the data, the Save Editor to Current Model dialog box will appear:



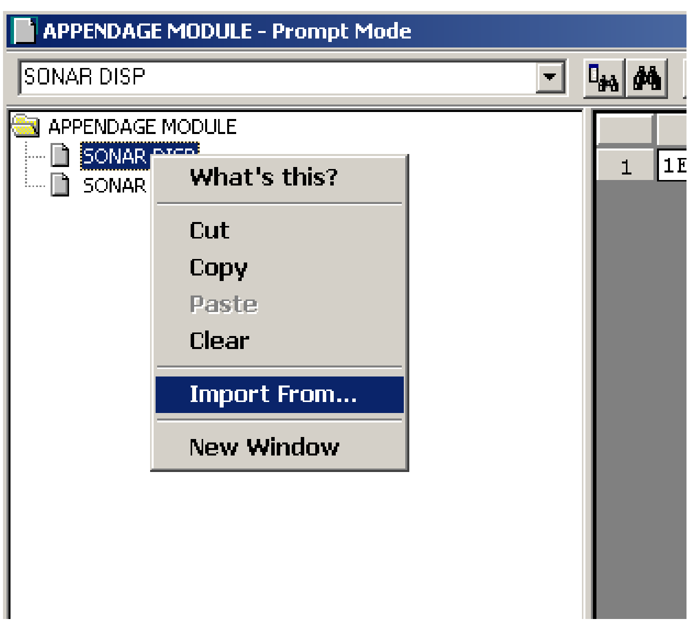
After clicking "Yes", the Error dialog box will appear.



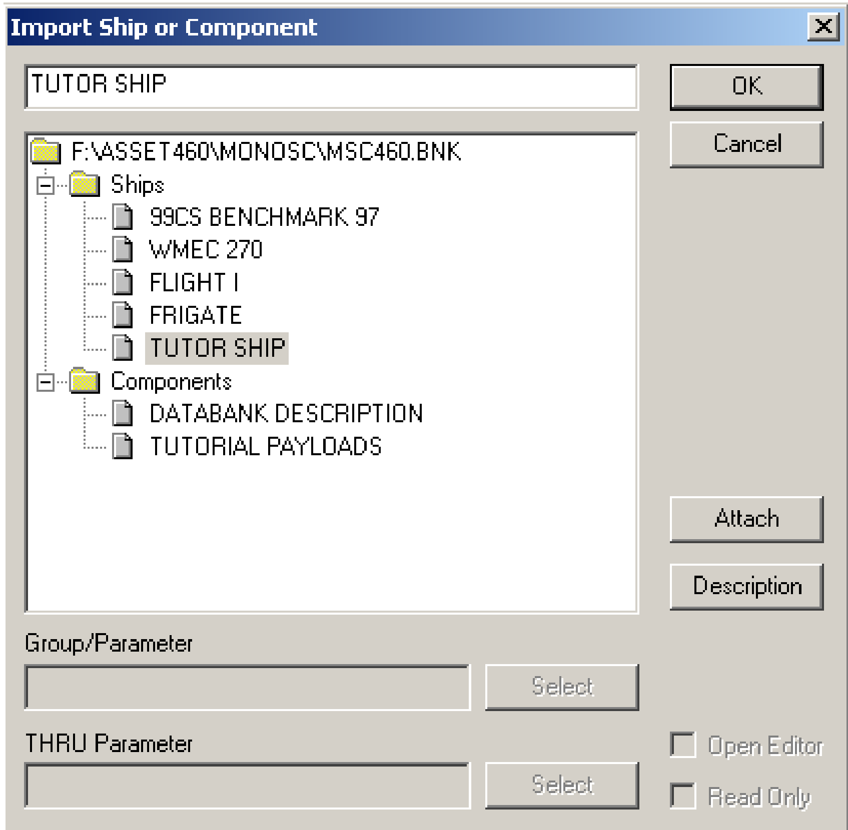
Since you set the SONAR DOME IND to **PRESENT**, ASSET is still requesting more data. After clicking "Yes", the next Parameter Edit dialog box appears:



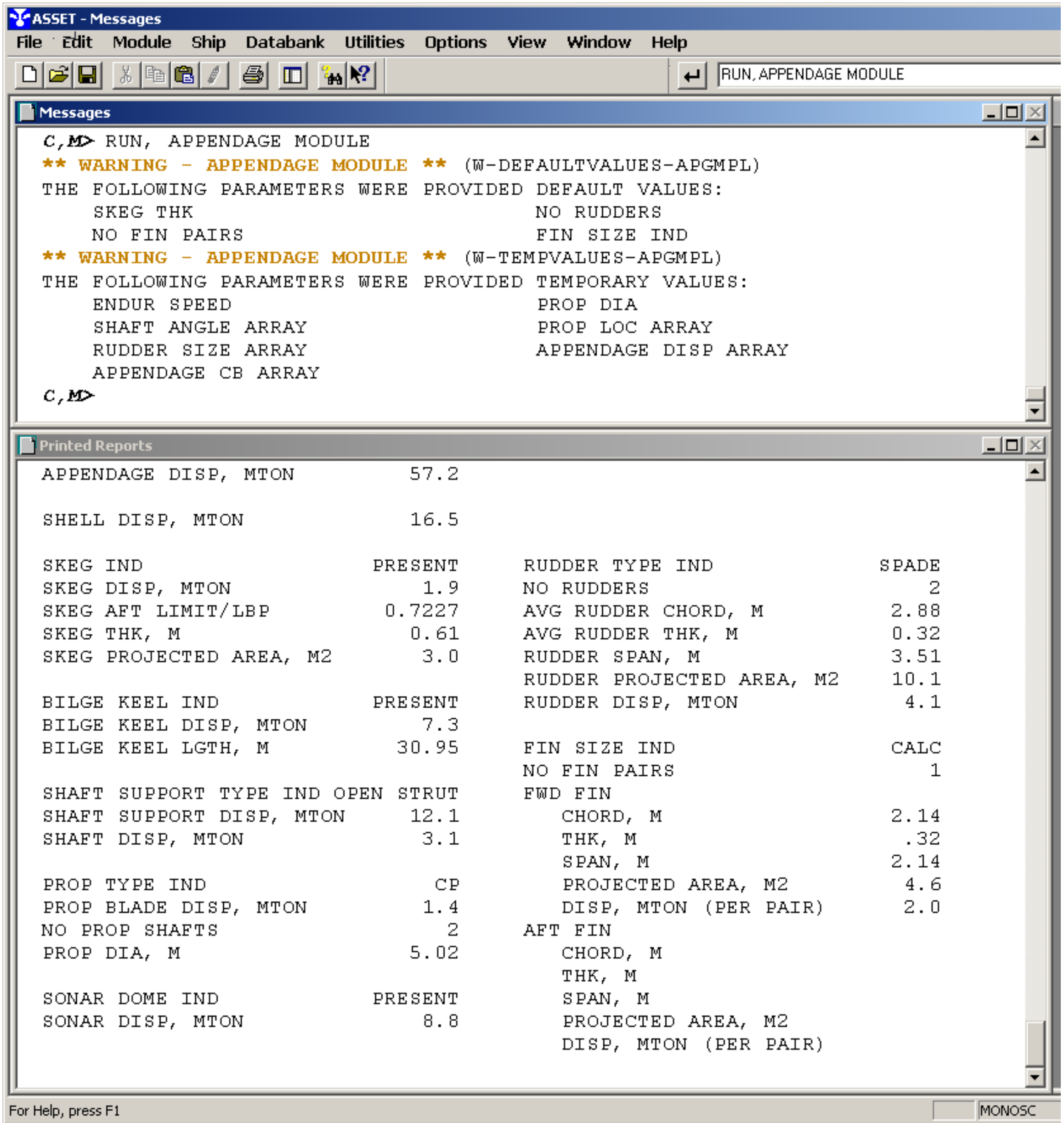
We will use the sonar data from the FRIGATE ship in the data bank for the sonar displacement and sonar CB position (SONAR DISP and SONAR CB ARRAY). To get the FRIGATE data, select the SONAR DISP parameter and click on the right button of your mouse. You should see this dialog box appear:



Select **Import From…** from the menu, and it will bring you to this window:

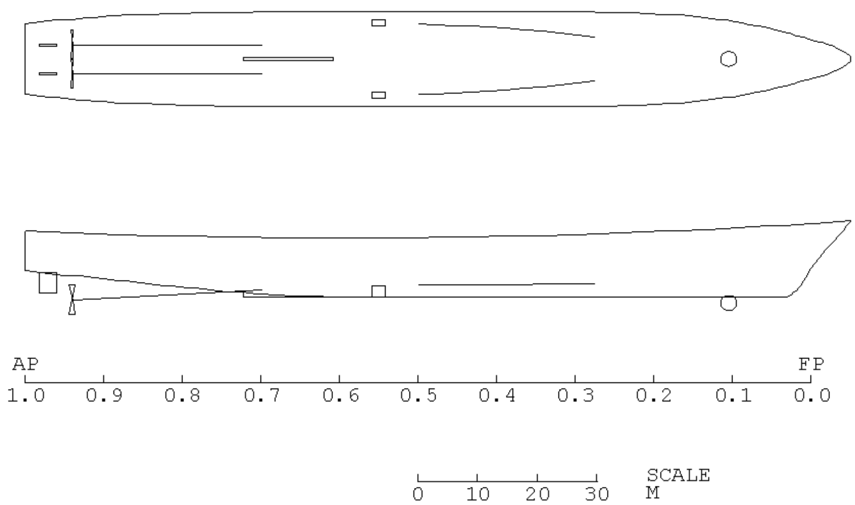


Select **FRIGATE** under the Ships folder. After clicking **OK**, ASSET will return to the previous window and insert the value of the SONAR DISP (**8.83961**). Repeat the process o get the values for the SONAR CB ARRAY (**13.716, -1.15824**). Click the Run button in the Editor, and the Save Editor to Current Model dialog box will appear. After clicking "Yes", ASSET will run the Appendage Module. The Messages and Printed Report windows will look like this:



The Appendage Module Summary printed report and Ship Profile/Plan View Appendages graphic report follow. Save your ship by selecting **Ship⇒Modify**.

ASSET/MONOSC V4.6.0 - APPENDAGE MODULE - 10/17/2000 12: 1.50
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - HULL PROFILE AND PLAN VIEW WITH APPENDAGES



ASSET/MONOSC V4.6.0 - APPENDAGE MODULE - 10/17/2000 12: 2.46
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP

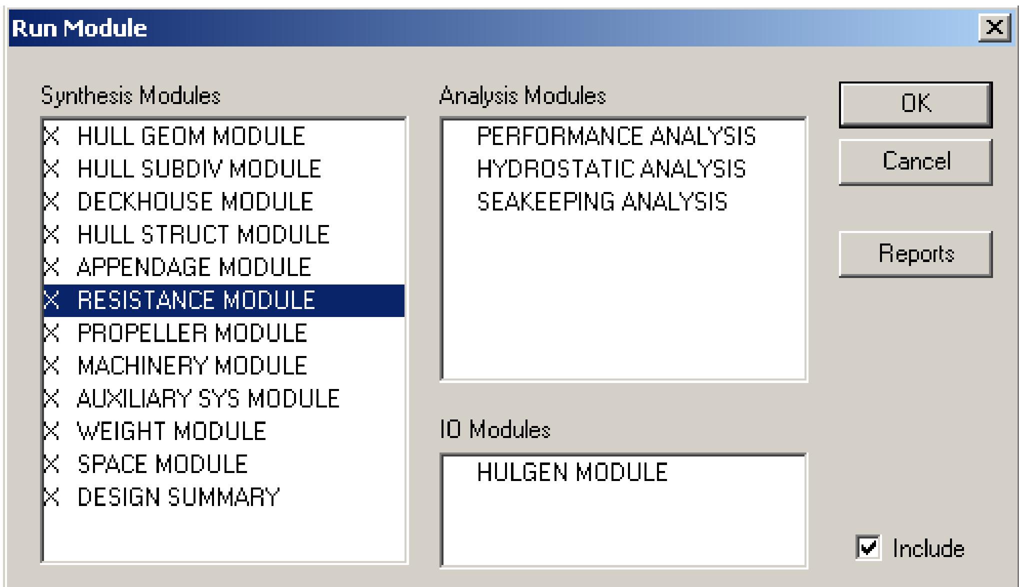
PRINTED REPORT NO. 1 - SUMMARY

APPENDAGE DISP, MTON	57.2
SHELL DISP, MTON	16.5
SKEG IND	PRESENT
SKEG DISP, MTON	1.9
SKEG AFT LIMIT/LBP	0.7227
SKEG THK, M	0.61
SKEG PROJECTED AREA, M2	3.0
BILGE KEEL IND	PRESENT
BILGE KEEL DISP, MTON	7.3
BILGE KEEL LGTH, M	30.95
SHAFT SUPPORT TYPE IND	OPEN STRUT
SHAFT SUPPORT DISP, MTON	12.1
SHAFT DISP, MTON	3.1
PROP TYPE IND	CP
PROP BLADE DISP, MTON	1.4
NO PROP SHAFTS	2
PROP DIA, M	5.02
SONAR DOME IND	PRESENT
SONAR DISP, MTON	8.8

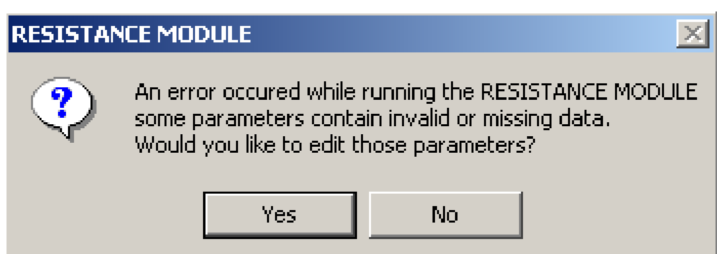
RUDDER TYPE IND	SPADE
NO RUDDERS	2
AVG RUDDER CHORD, M	2.88
AVG RUDDER THK, M	0.32
RUDDER SPAN, M	3.51
RUDDER PROJECTED AREA, M2	10.1
RUDDER DISP, MTON	4.1
FIN SIZE IND	CALC
NO FIN PAIRS	1
FWD FIN	
CHORD, M	2.14
THK, M	.32
SPAN, M	2.14
PROJECTED AREA, M2	4.6
DISP, MTON (PER PAIR)	2.0
AFT FIN	
CHORD, M	
THK, M	
SPAN, M	
PROJECTED AREA, M2	
DISP, MTON (PER PAIR)	

6.11 RESISTANCE MODULE

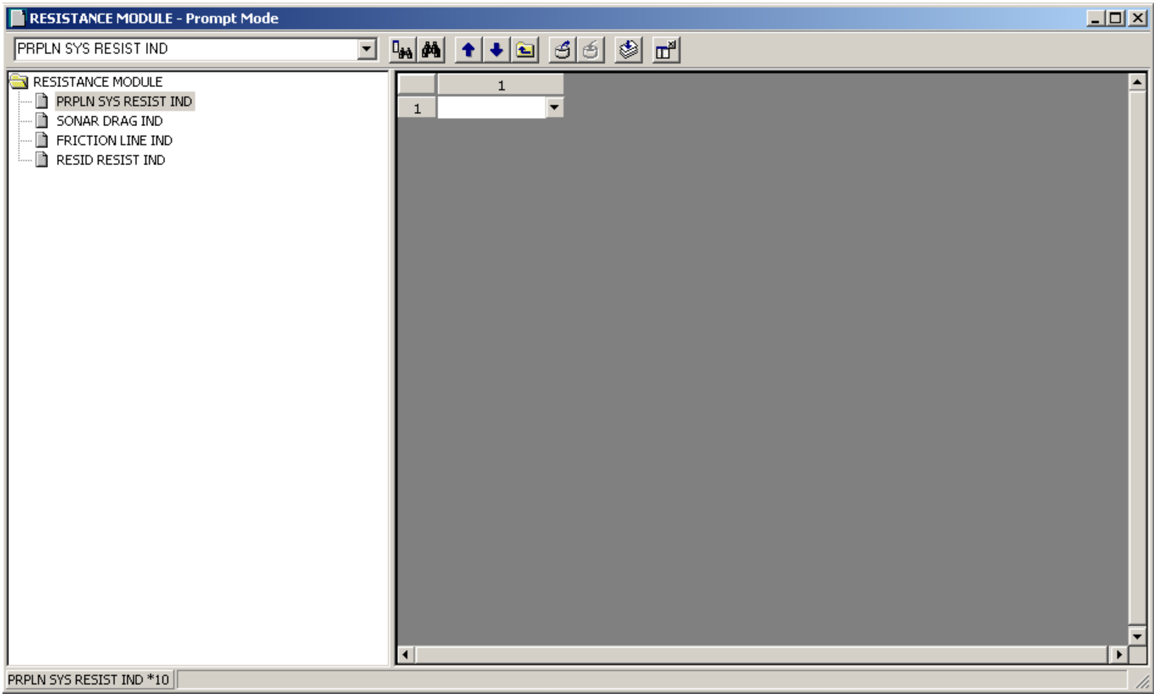
This module calculates the ship resistance based on the sum of frictional, residuary, appendage, and wind resistance (plus a resistance margin). Calm seas and a clean hull are assumed. After selecting Run from the Module menu, you will see this dialog box:



After selecting the Resistance Module, click "OK", and you will get the following error message:



After clicking "Yes", you will come to the first Resistance Module Edit Prompt Screen. It will look like this:



Check the on-line help for definitions for each of these parameters. Enter the following values for the parameters:

PRPLN SYS RESIST IND: **CALC**

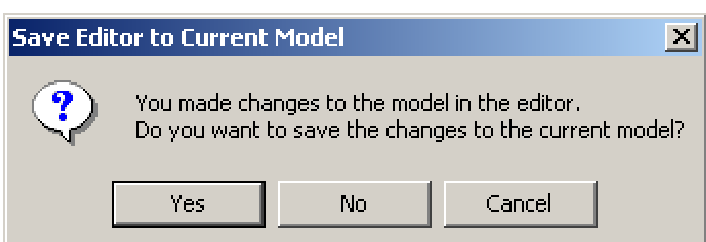
SONAR DRAG IND: **APPENDAGE**

FRICTION LINE IND: **ITTC**

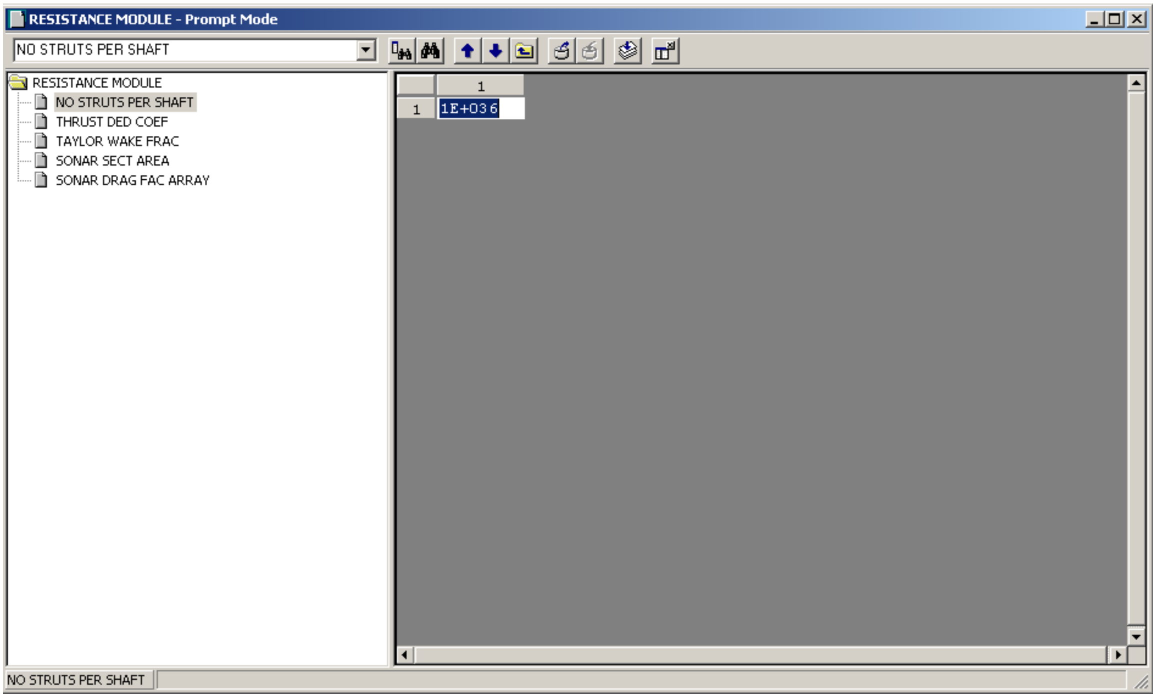
RESID RESIST IND: **REGR**

Note: The **TAYLOR** option could be used for the RESID RESIS IND. However, a fatal error is given if the hull form characteristics are outside the applicable range of the Taylor Series. This will often happen before a design has been run through Synthesis. Thus, **REGR** is a better choice at this time. Later the RESID RESIS IND may be changed to **TAYLOR** if desired.

After completing the data entries, the Save Editor for Current Model appears:



After clicking "Yes", ASSET will run the module again. The Error Message dialog box appears, informing you that ASSET requires more data to run the module. After you enter "Yes", the second Resistance Module Editor Prompt window appears:



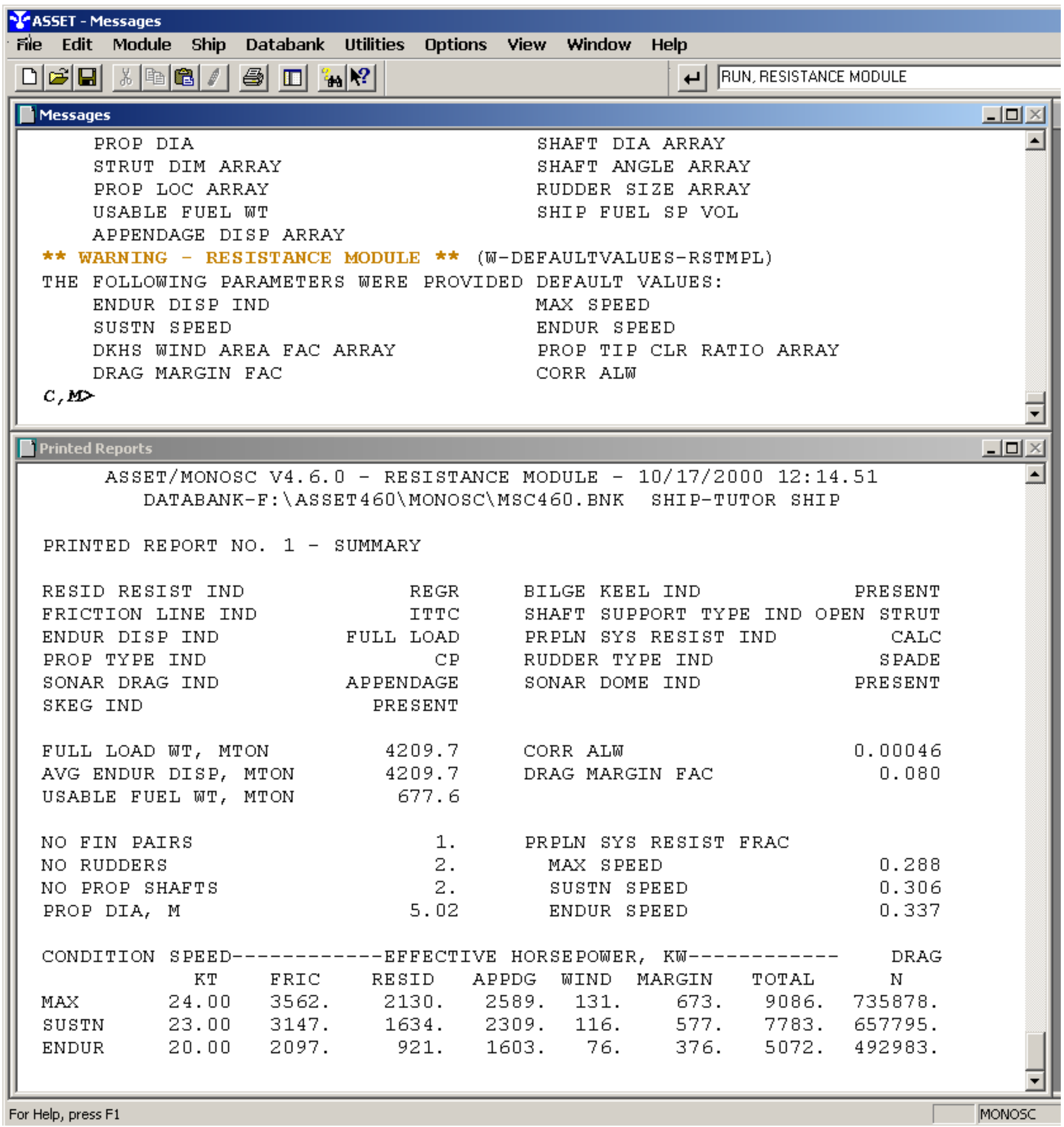
Enter the following values for these parameters:

NO STRUCTS PER SHAFT: **1**
THRUST DED COEF: **FLIGHT I SHIP DATA**
TAYLOR WAKE FRAC: **FLIGHT I SHIP DATA**
SONAR SECT AREA: **FRIGATE SHIP DATA**
SONAR DRAG FAC ARRAY: **FRIGATE SHIP DATA**

Note: There are no good equations to quickly estimate these parameters so values from similar, pre-existing designs should be used. For the THRUST DED COEF and TAYLOR WAKE FRAC, you should use the **FLIGHT I** data because your ship, like the FLIGHT I, is a twin screw ship. Additionally, the Hull Geometry Module set the HULL BC IND parameter for your design to **DDG 51**, so the thrust deduction coefficient and

Taylor wake fraction of FLIGHT I should be closer to your design. Likewise, the sonar dome on your ship is the same sonar dome as on the FRIGATE ship. Therefore, the sonar section area and the sonar drag factor array use the parameters found in the **FRIGATE** model. To obtain these data points, see Section 6.10 for complete instructions.

After entering the parameters, the Save Editor to Current Model dialog box will appear. After clicking "Yes", ASSET will run the module. The Message and Printed Reports windows will look like this:

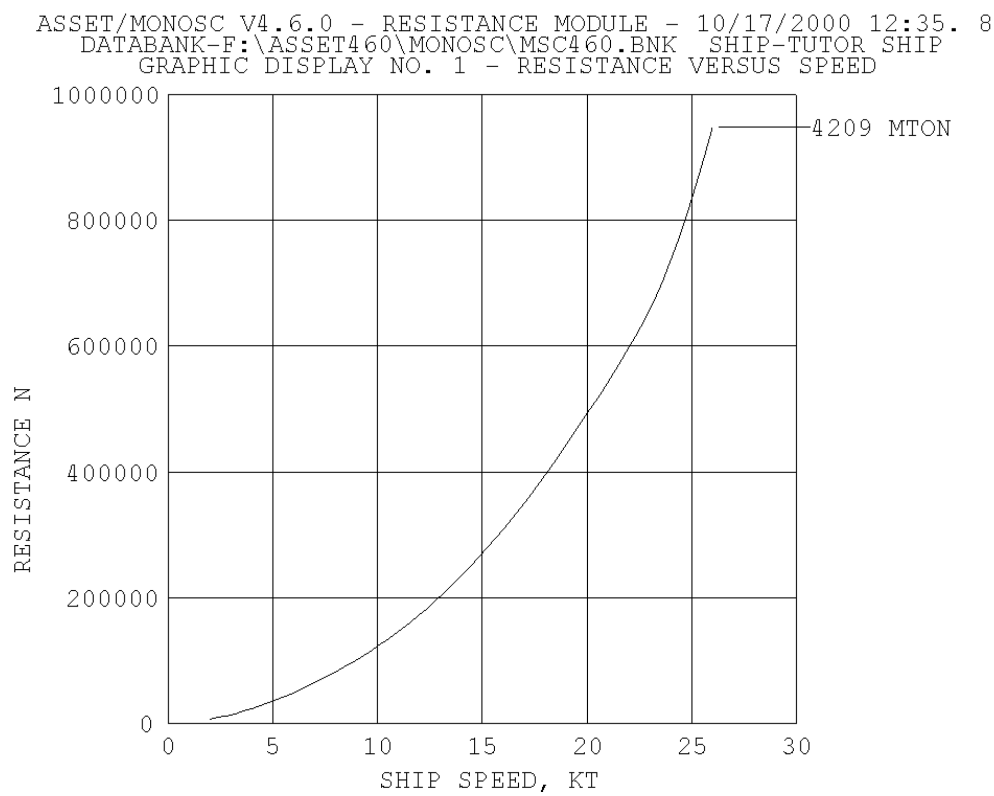


Review the parameters that were given default values. SUSTN SPEED and ENDUR SPEED are specified in your Design Requirements, Section 6.2. The default values set by the Resistance Module do not match the requirements. Go to the Editor and make the following changes:

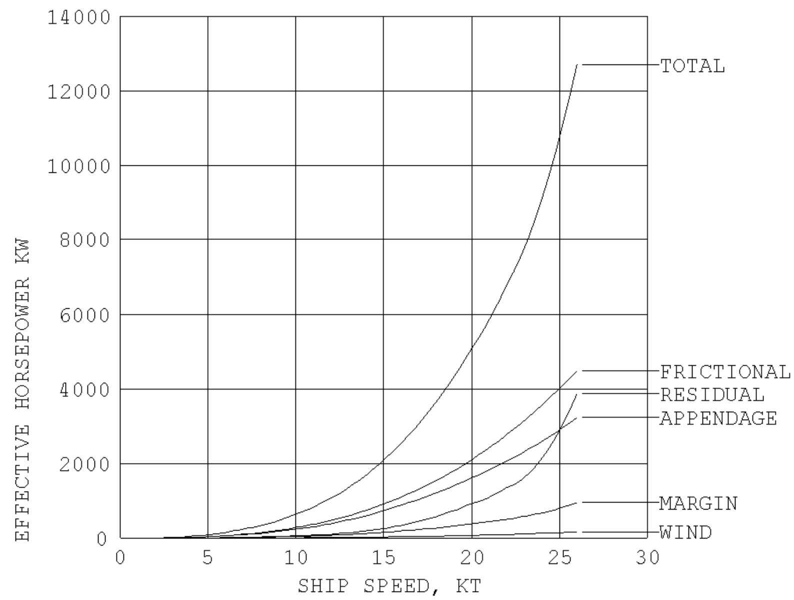
SUSTN SPEED: **from 23 to 24 knots**

ENDUR SPEED: **from 20 to 18 knots**

After making the changes, exit the editor and save your changes. Rerun the Resistance Module. The Resistance Module summary printed report and resistance vs. speed and EHP vs. speed plots follow.



ASSET/MONOSC V4.6.0 - RESISTANCE MODULE - 10/17/2000 12:27.59
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 2 - EHP VERSUS SPEED

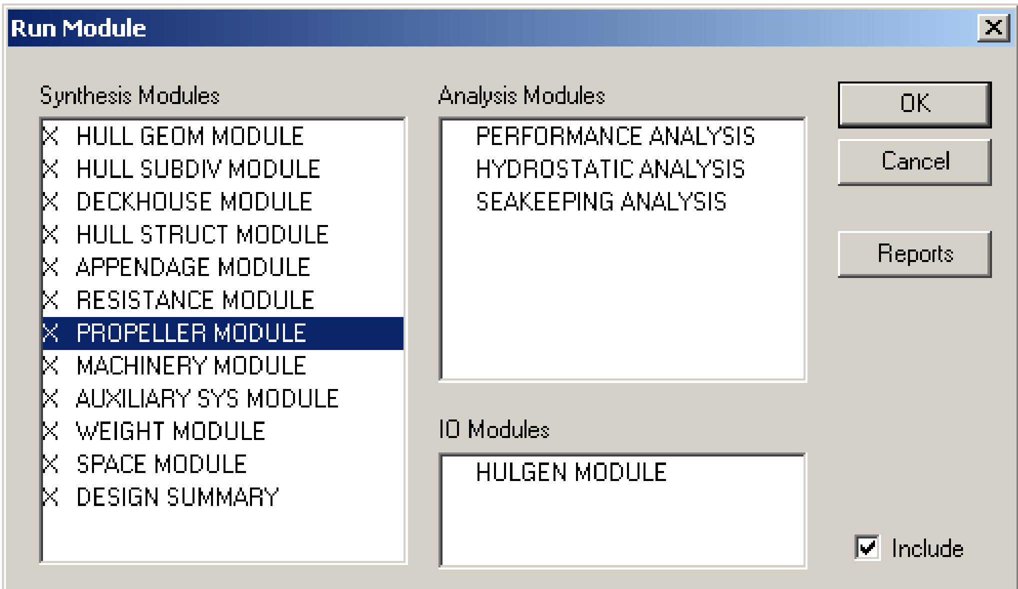


DISPLACEMENT = 4209 MTON

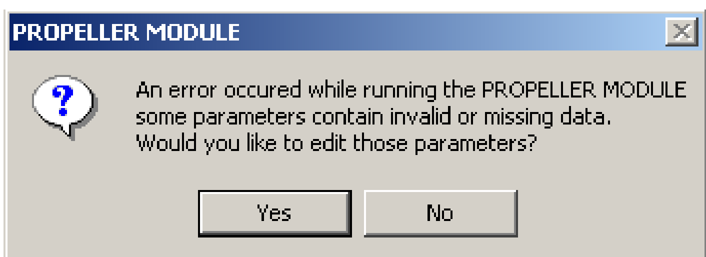
```
     ASSET/MONOSC V4.6.0 - RESISTANCE MODULE - 10/17/2000 12:35.32
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

RESID RESIST IND              REGR     BILGE KEEL IND             PRESENT
FRICTION LINE IND             ITTC     SHAFT SUPPORT TYPE IND OPEN STRUT
ENDUR DISP IND           FULL LOAD     PRPLN SYS RESIST IND          CALC
PROP TYPE IND                   CP     RUDDER TYPE IND              SPADE
SONAR DRAG IND           APPENDAGE     SONAR DOME IND             PRESENT
SKEG IND                   PRESENT

FULL LOAD WT, MTON          4209.7     CORR ALW                   0.00046
AVG ENDUR DISP, MTON        4209.7     DRAG MARGIN FAC              0.080
USABLE FUEL WT, MTON         677.6

NO FIN PAIRS                    1.     PRPLN SYS RESIST FRAC
NO RUDDERS                      2.       MAX SPEED                  0.288
NO PROP SHAFTS                  2.       SUSTN SPEED                0.306
PROP DIA, M                   5.02       ENDUR SPEED                0.337

CONDITION SPEED------------EFFECTIVE HORSEPOWER, KW------------    DRAG
            KT    FRIC    RESID   APPDG  WIND  MARGIN   TOTAL       N
MAX       24.00   3562.    2130.   2589.  131.    673.   9086.  735878.
SUSTN     23.00   3147.    1634.   2309.  116.    577.   7783.  657795.
ENDUR     20.00   2097.     921.   1603.   76.    376.   5072.  492983.
```

6.12 PROPELLER MODULE

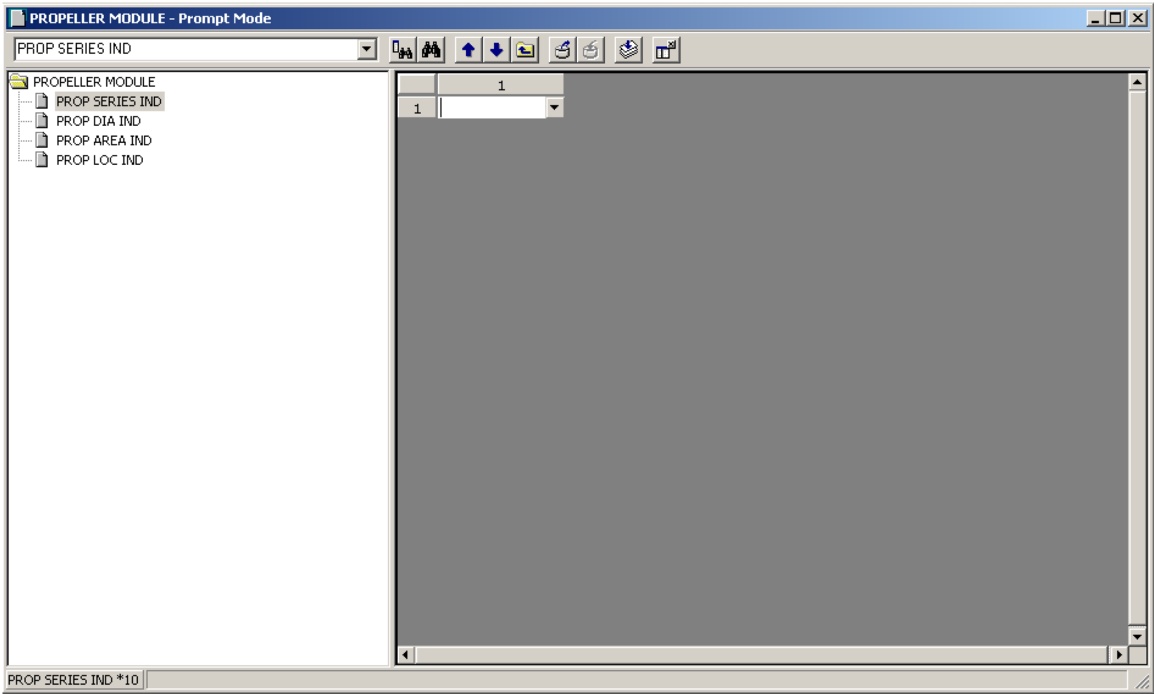
This module determines the geometric characteristics of the ship's propeller(s) and calculates the power that must be supplied to achieve various speeds. After selecting Run from the Module menu, this dialog box appears:



Choose the Propeller Module and click OK. The following error message will appear:



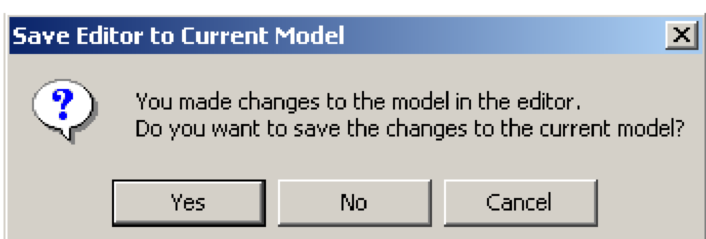
After clicking "Yes", the Propeller Module Editor Prompt window appears:



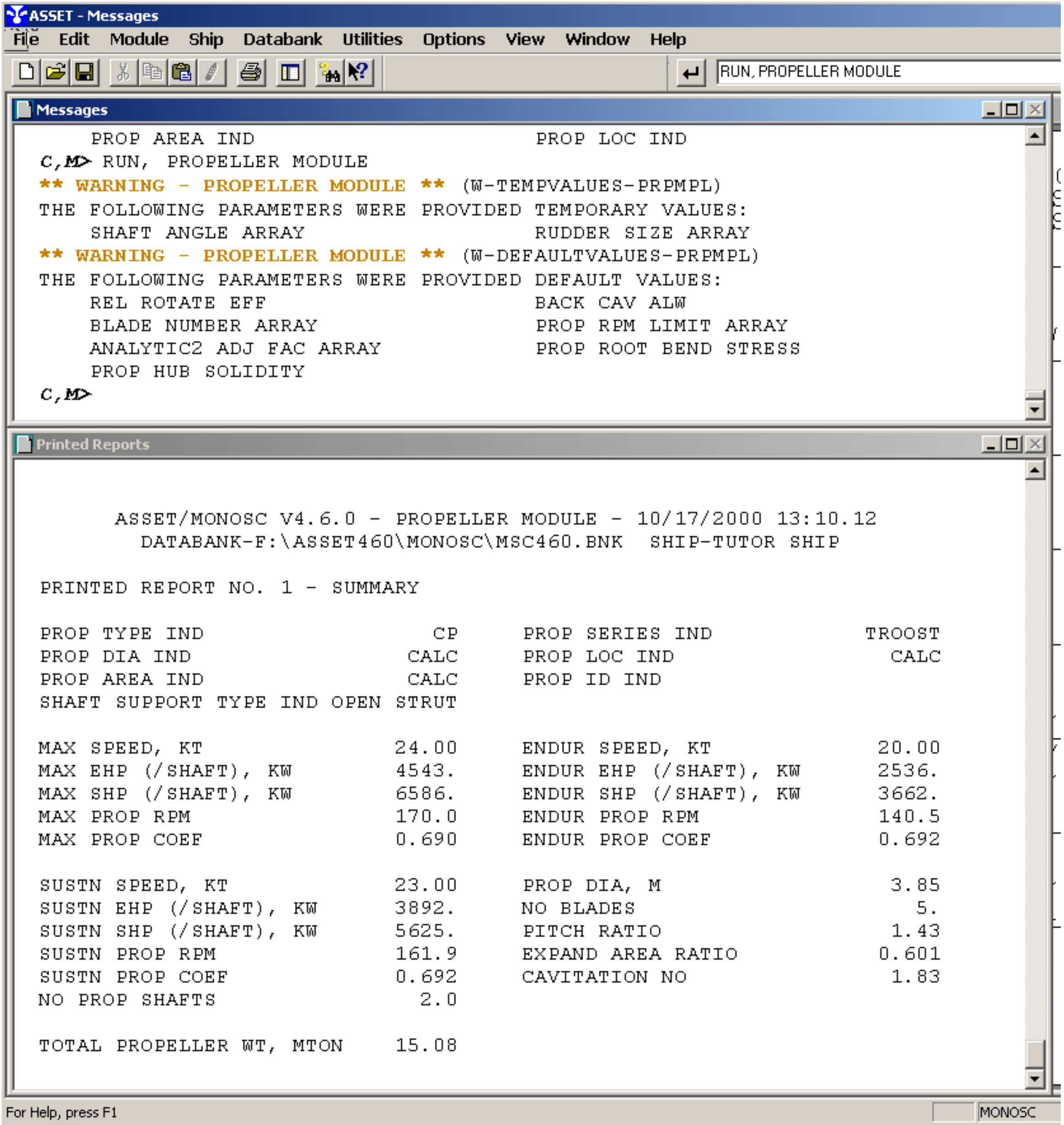
Check the on-line help for definitions of these parameters (Click the right mouse button and select **What's This?)** Enter the following values for each of the parameters:

PROP SERIES IND: **TROOST**
PROP DIA IND: **CALC**
PROP AREA IND: **CALC**
PROP LOC IND: **CALC**

After entering the data, the Save Editor to Current Model dialog box appears:



After clicking "Yes", ASSET will run the Propeller Module. The Message and Printed Reports windows will look like this:



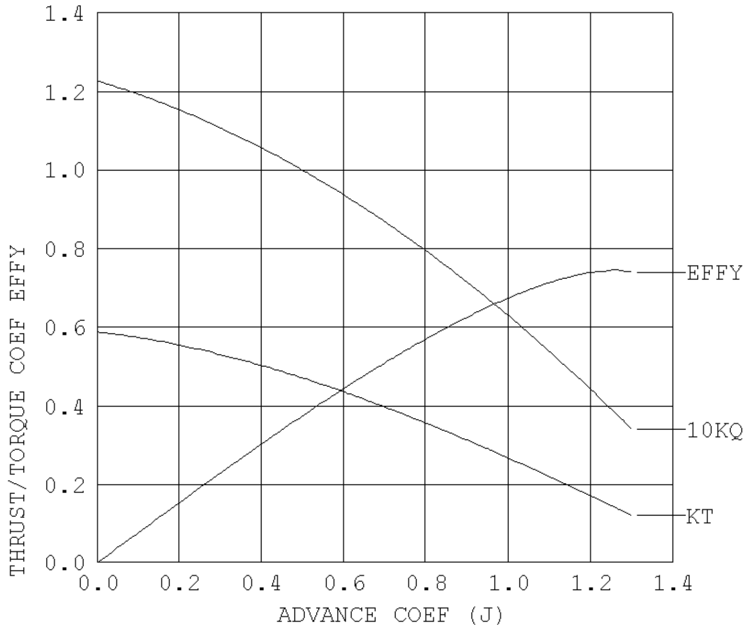

```
     PROP AREA IND                       PROP LOC IND
C,M> RUN, PROPELLER MODULE
** WARNING - PROPELLER MODULE ** (W-TEMPVALUES-PRPMPL)
THE FOLLOWING PARAMETERS WERE PROVIDED TEMPORARY VALUES:
     SHAFT ANGLE ARRAY                   RUDDER SIZE ARRAY
** WARNING - PROPELLER MODULE ** (W-DEFAULTVALUES-PRPMPL)
THE FOLLOWING PARAMETERS WERE PROVIDED DEFAULT VALUES:
     REL ROTATE EFF                      BACK CAV ALW
     BLADE NUMBER ARRAY                  PROP RPM LIMIT ARRAY
     ANALYTIC2 ADJ FAC ARRAY             PROP ROOT BEND STRESS
     PROP HUB SOLIDITY
C,M>
```



```
        ASSET/MONOSC V4.6.0 - PROPELLER MODULE - 10/17/2000 13:10.12
          DATABANK-F:\ASSET460\MONOSC\MSC460.BNK   SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

PROP TYPE IND                  CP      PROP SERIES IND            TROOST
PROP DIA IND                 CALC      PROP LOC IND                 CALC
PROP AREA IND                CALC      PROP ID IND
SHAFT SUPPORT TYPE IND OPEN STRUT

MAX SPEED, KT               24.00      ENDUR SPEED, KT             20.00
MAX EHP (/SHAFT), KW        4543.      ENDUR EHP (/SHAFT), KW      2536.
MAX SHP (/SHAFT), KW        6586.      ENDUR SHP (/SHAFT), KW      3662.
MAX PROP RPM                170.0      ENDUR PROP RPM              140.5
MAX PROP COEF               0.690      ENDUR PROP COEF             0.692

SUSTN SPEED, KT             23.00      PROP DIA, M                  3.85
SUSTN EHP (/SHAFT), KW      3892.      NO BLADES                      5.
SUSTN SHP (/SHAFT), KW      5625.      PITCH RATIO                  1.43
SUSTN PROP RPM              161.9      EXPAND AREA RATIO           0.601
SUSTN PROP COEF             0.692      CAVITATION NO                1.83
NO PROP SHAFTS                2.0

TOTAL PROPELLER WT, MTON    15.08
```

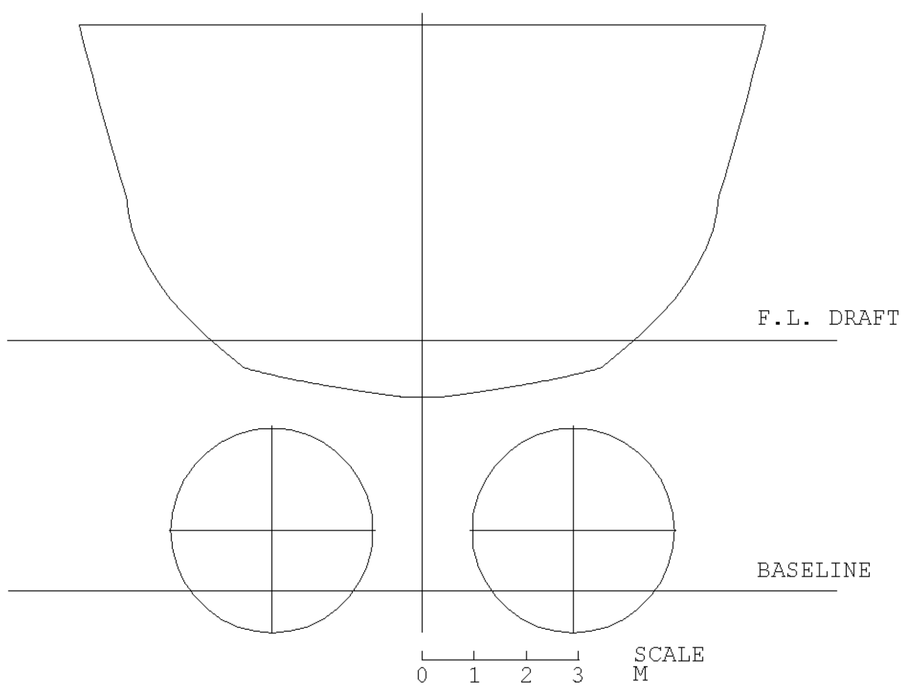

Note the parameters that were set to default values. Everything is OK for now. The Propeller Module Summary printed report and the two propeller Graphic reports (open water diagram and transverse section) follow.

ASSET/MONOSC V4.6.0 - PROPELLER MODULE - 10/17/2000 13:15.38
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - OPEN WATER DIAGRAM



PROP SERIES IND-TROOST PROP ID IND-

ASSET/MONOSC V4.6.0 - PROPELLER MODULE - 10/17/2000 13:15.38
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 2 - TRANSVERSE SECTION

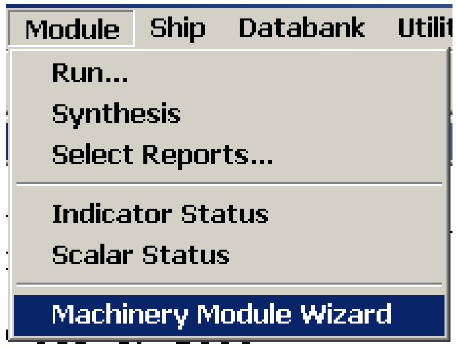


```
      ASSET/MONOSC V4.6.0 - PROPELLER MODULE - 10/17/2000 13:22.41
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

PROP TYPE IND                   CP     PROP SERIES IND           TROOST
PROP DIA IND                  CALC     PROP LOC IND                CALC
PROP AREA IND                 CALC     PROP ID IND
SHAFT SUPPORT TYPE IND OPEN STRUT

MAX SPEED, KT                24.00     ENDUR SPEED, KT            20.00
MAX EHP (/SHAFT), KW         4543.     ENDUR EHP (/SHAFT), KW     2536.
MAX SHP (/SHAFT), KW         6586.     ENDUR SHP (/SHAFT), KW     3662.
MAX PROP RPM                 170.0     ENDUR PROP RPM             140.5
MAX PROP COEF                0.690     ENDUR PROP COEF            0.692

SUSTN SPEED, KT              23.00     PROP DIA, M                 3.85
SUSTN EHP (/SHAFT), KW       3892.     NO BLADES                     5.
SUSTN SHP (/SHAFT), KW       5625.     PITCH RATIO                 1.43
SUSTN PROP RPM               161.9     EXPAND AREA RATIO          0.601
SUSTN PROP COEF              0.692     CAVITATION NO               1.83
NO PROP SHAFTS                 2.0

TOTAL PROPELLER WT, MTON     15.08
```

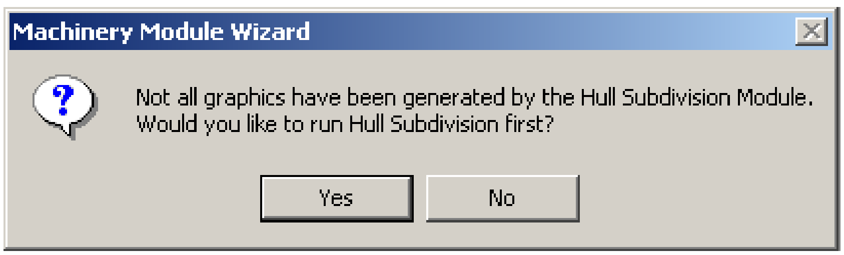
Save your ship, from the menu select **Ship⇒Modify**.

6.13 MACHINERY MODULE

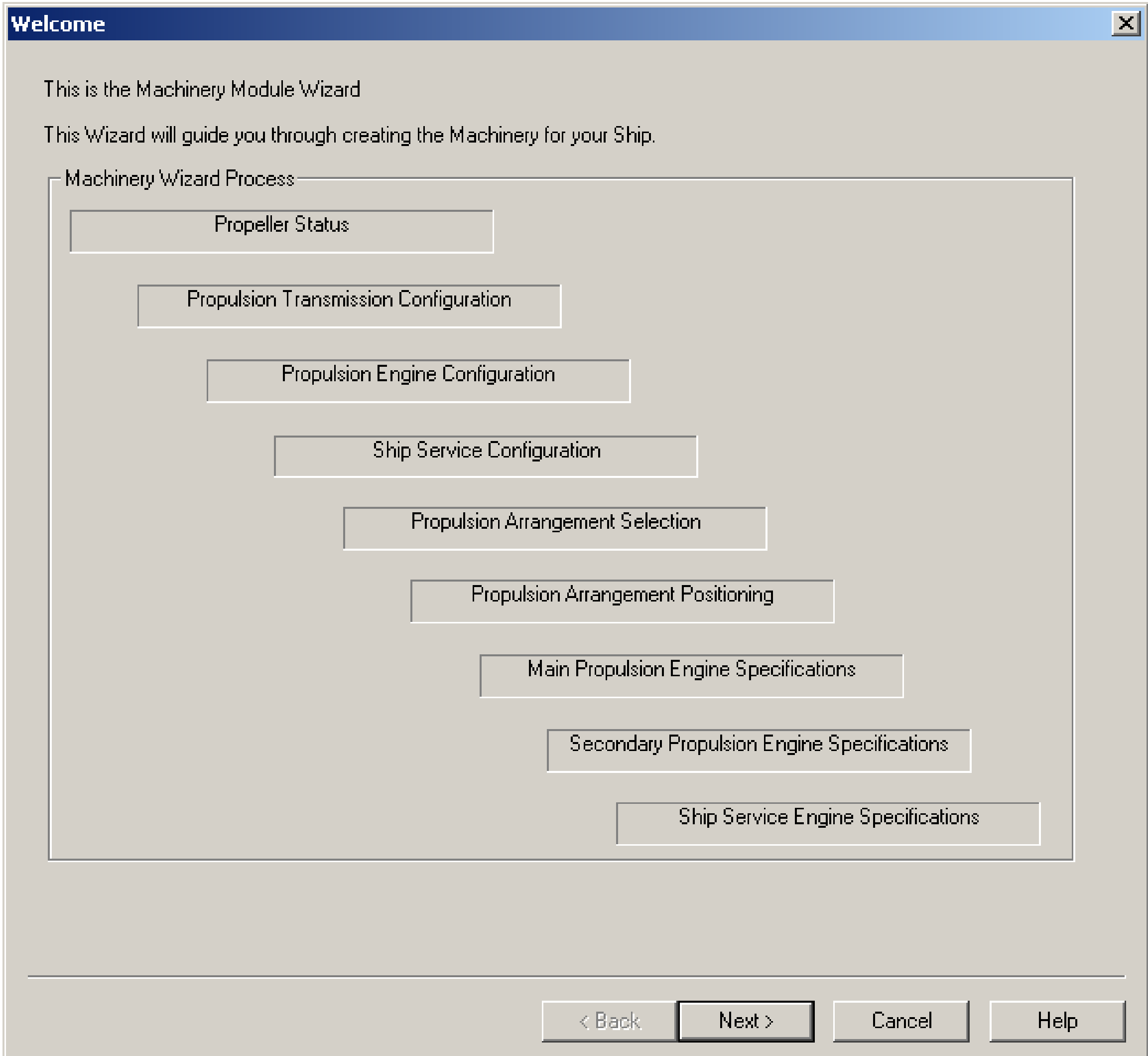
The Machinery Module computes ship service electric and propulsion power requirements and performs sizing of the following ship elements: main propulsion machinery, secondary propulsion machinery, and electric plant. Due to the many system and technology options available in the Machinery Module, ASSET includes a Machine Module Wizard to assist you in the selection of machinery options. This wizard will prompt you to make selections on the equipment characteristics of the propulsion system you will design. You will select this option from the Module menu:



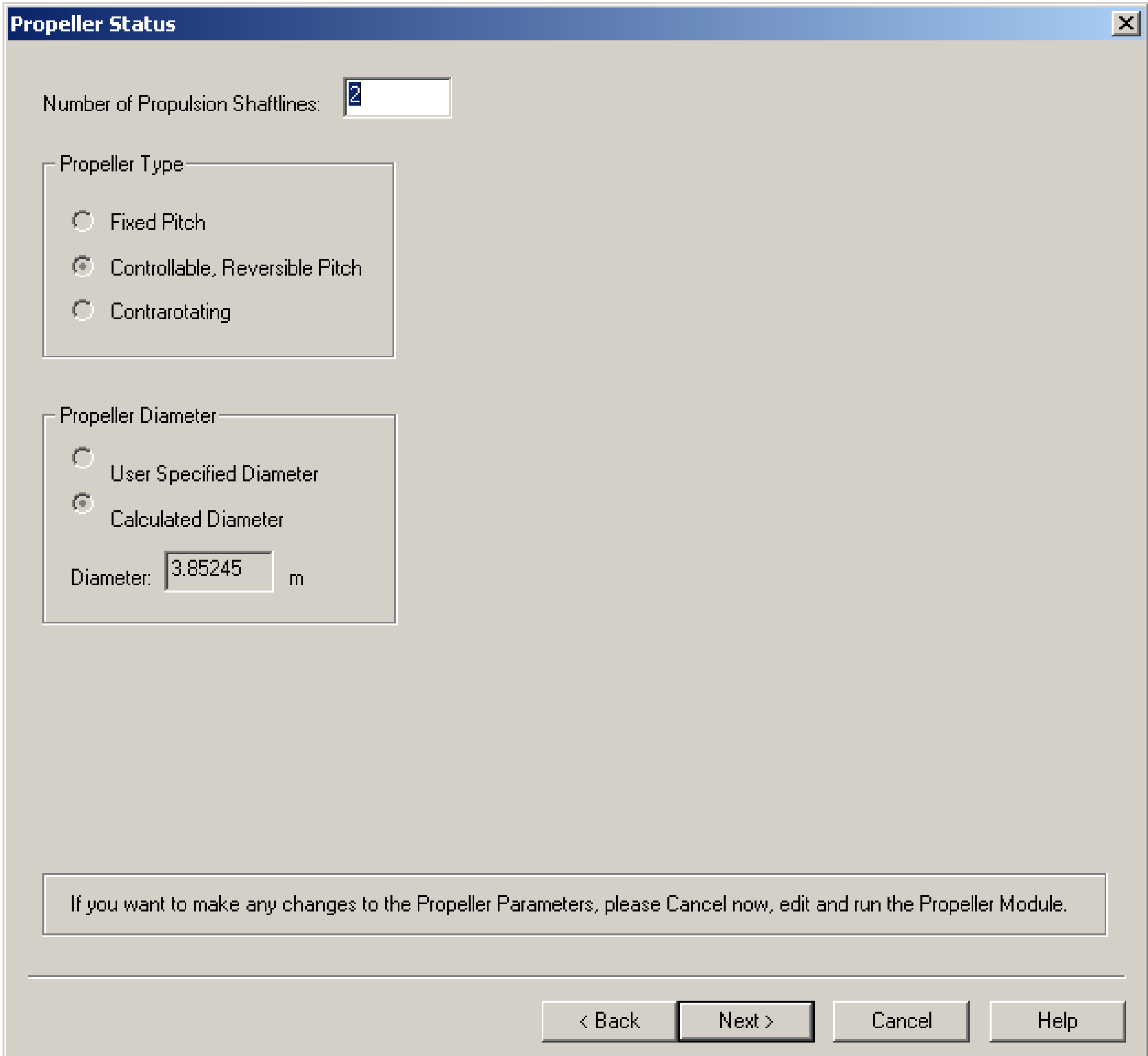
After selecting the Machinery Module Wizard, you might get this message:



If you get this message, select "Yes" and ASSET will run the Hull Subdivision Module again. This is responding to ASSET's request for more information. After the Hull Subdivision Module is finished, you will see this dialog box:



This window summarizes the steps you will take to complete the Machinery Module Wizard. Please consult the on-line help for more information about the wizard in general or any part of the wizard. After you click "Next", the Propeller Status window will appear:



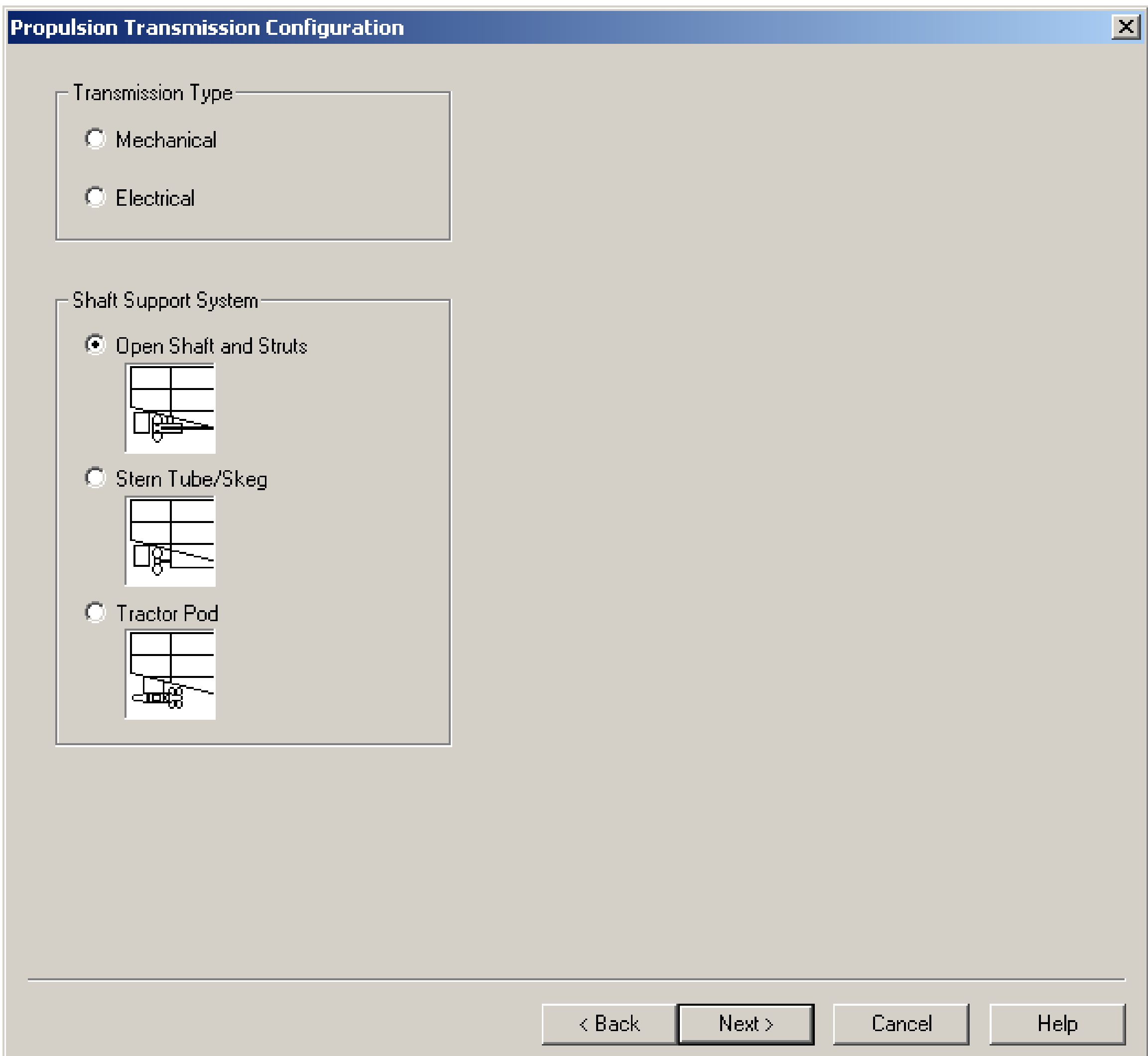
This window will show you the characteristics of the propeller determined by the Propeller Module. The following information should be on the Propeller Status window:

NUMBER OF PROPULSION SHAFTLINES—**2**
PROPELLER TYPE—**CONTROLLABLE, REVERSIBLE PITCH**
PROPELLER DIAMETER—**CALCULATED DIAMETER**

If the data does not match the information shown above (the propeller diameter need not match exactly), you should exit the Machinery Module Wizard (click the **Cancel** button) and return to Section 6.12. Open the Editor, ensure the parameters identified in Section

6.12 are set as specified, save any changes as you exit the Editor and then rerun the Propeller Module. The propeller configuration influences many other machinery plant options, so it is important to have the desired propeller characteristics before proceeding with the Machinery Module Wizard.

After ensuring the above data is entered into the window, click “Next” and the next window—the Propulsion Transmission Configuration—will appear:

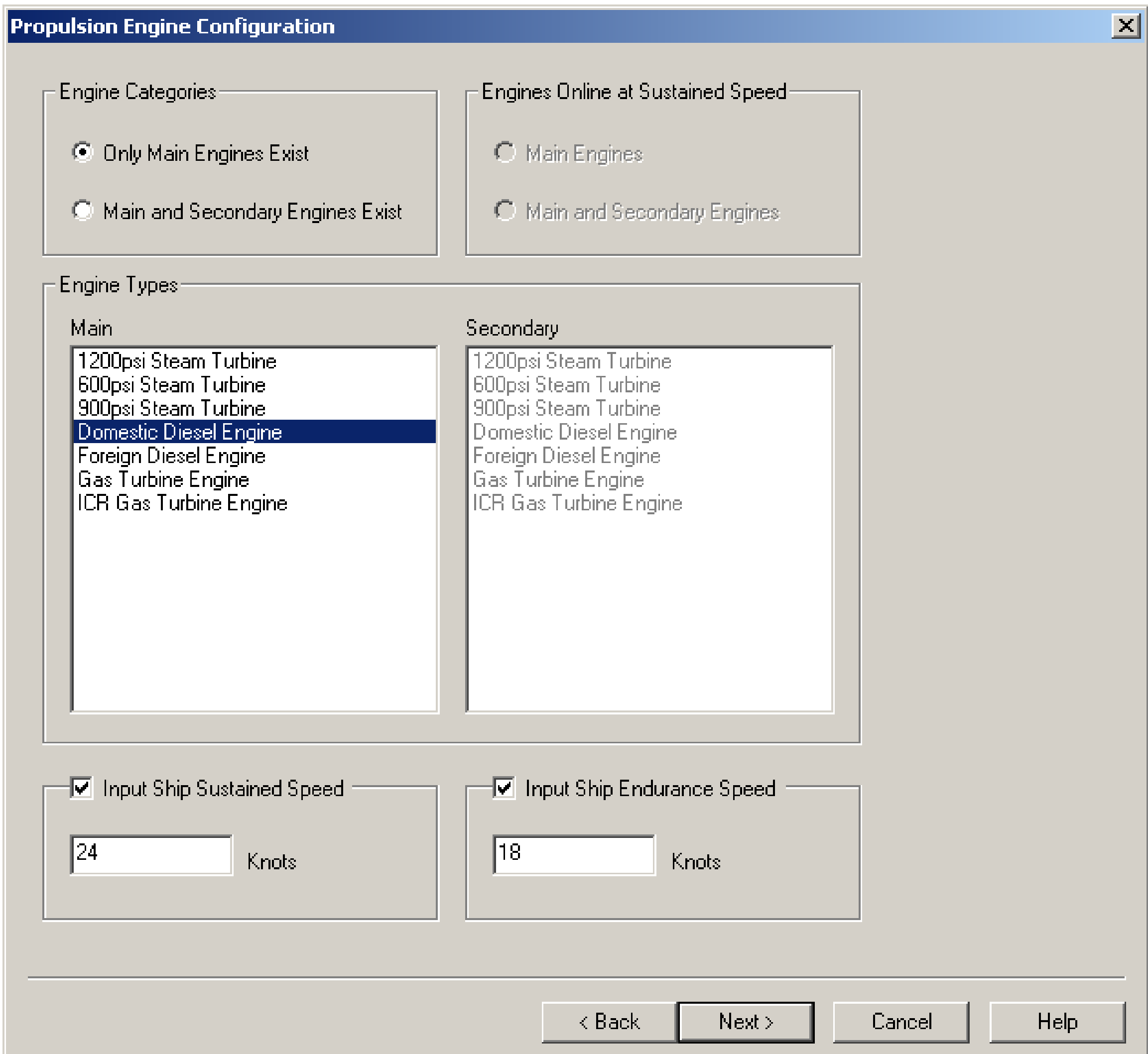


This dialog will help you determine the characteristics of the transmission of the propulsion system. The following values should be selected in this window:

TRANSMISSION TYPE—**MECHANICAL**

SHAFT SUPPORT SYSTEM—**OPEN SHAFT AND STRUTS**

After entering the data, click "Next", and the next window—the Propulsion Engine Configuration—will appear:



This window will help determine the configuration of the main propulsion engines. The following values should be selected in this window:

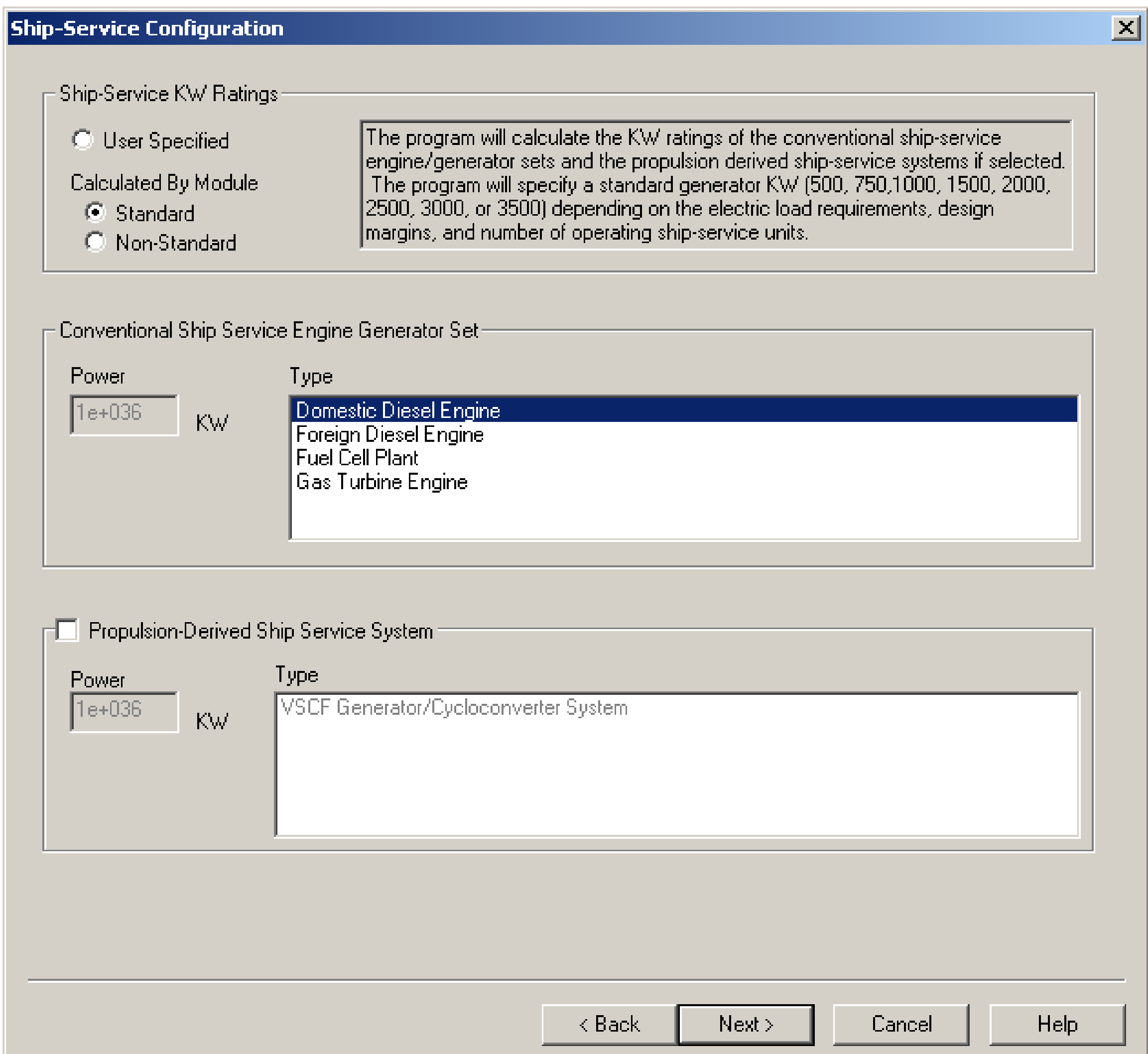
ENGINE CATEGORIES—**ONLY MAIN ENGINES EXIST**

ENGINE TYPE—**DOMESTIC DIESEL ENGINE**

Since you selected **ONLY MAIN ENGINES EXIST**, the other half of the screen—**ENGINES ONLINE AT SUSTAINED SPEED**—is inactive. Since the design has no secondary engines, you did not have to choose an engine from the Secondary column.

Ensure that the check boxes "Input Ship Sustained Speed" and "Input Ship Endurance Speed" are both checked. You entered the sustained speed and endurance speed previously based on the design requirements. Checking these boxes will ensure that the Machinery Module provides sufficient power to achieve these requirements.

After inputting the data, click "Next", and the next window—the Ship Service Configuration—will appear:

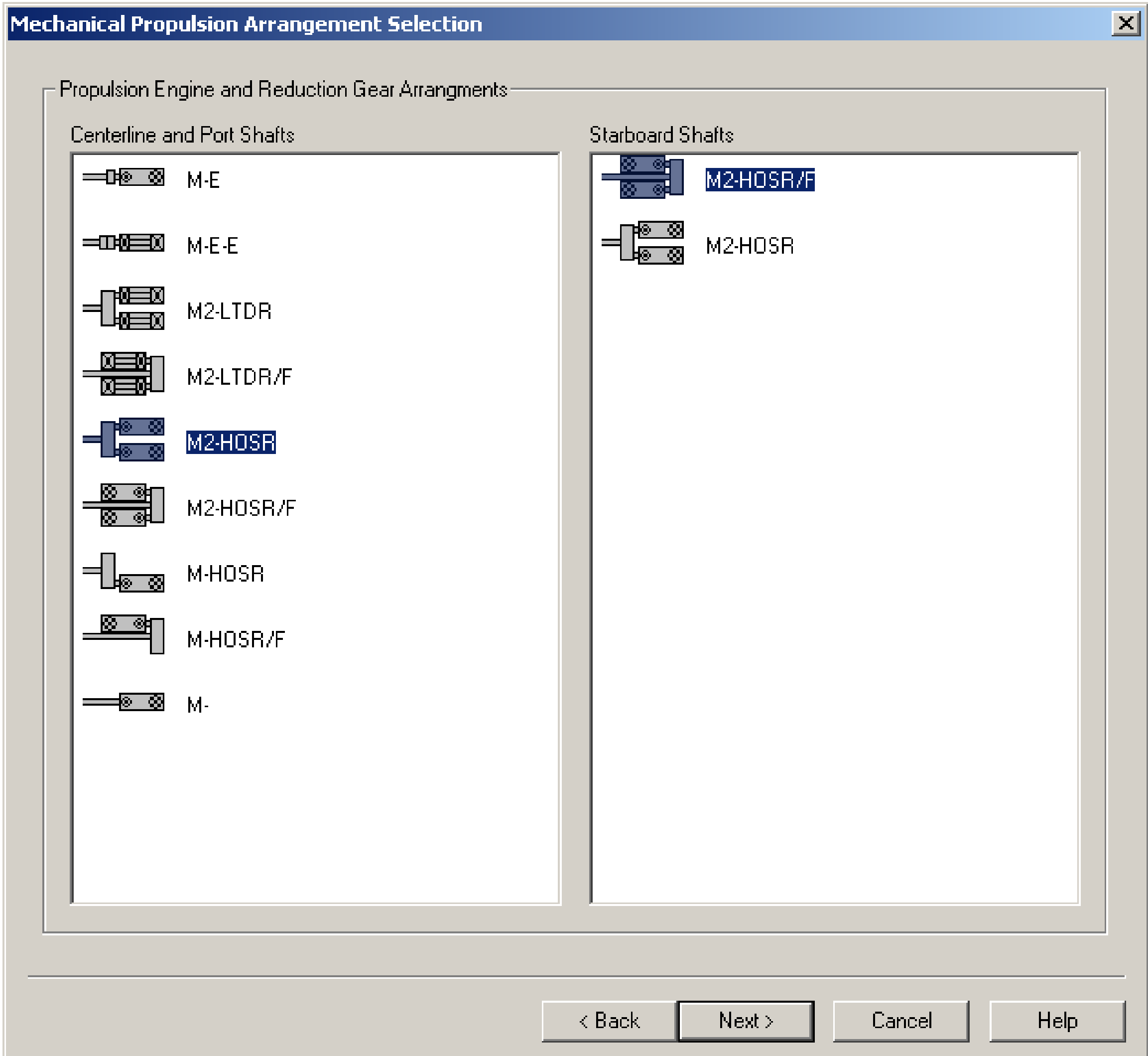


This window will help you determine the configuration of the ship service system and calculate power ratings for the ship service engines. The following values should be selected in this window:

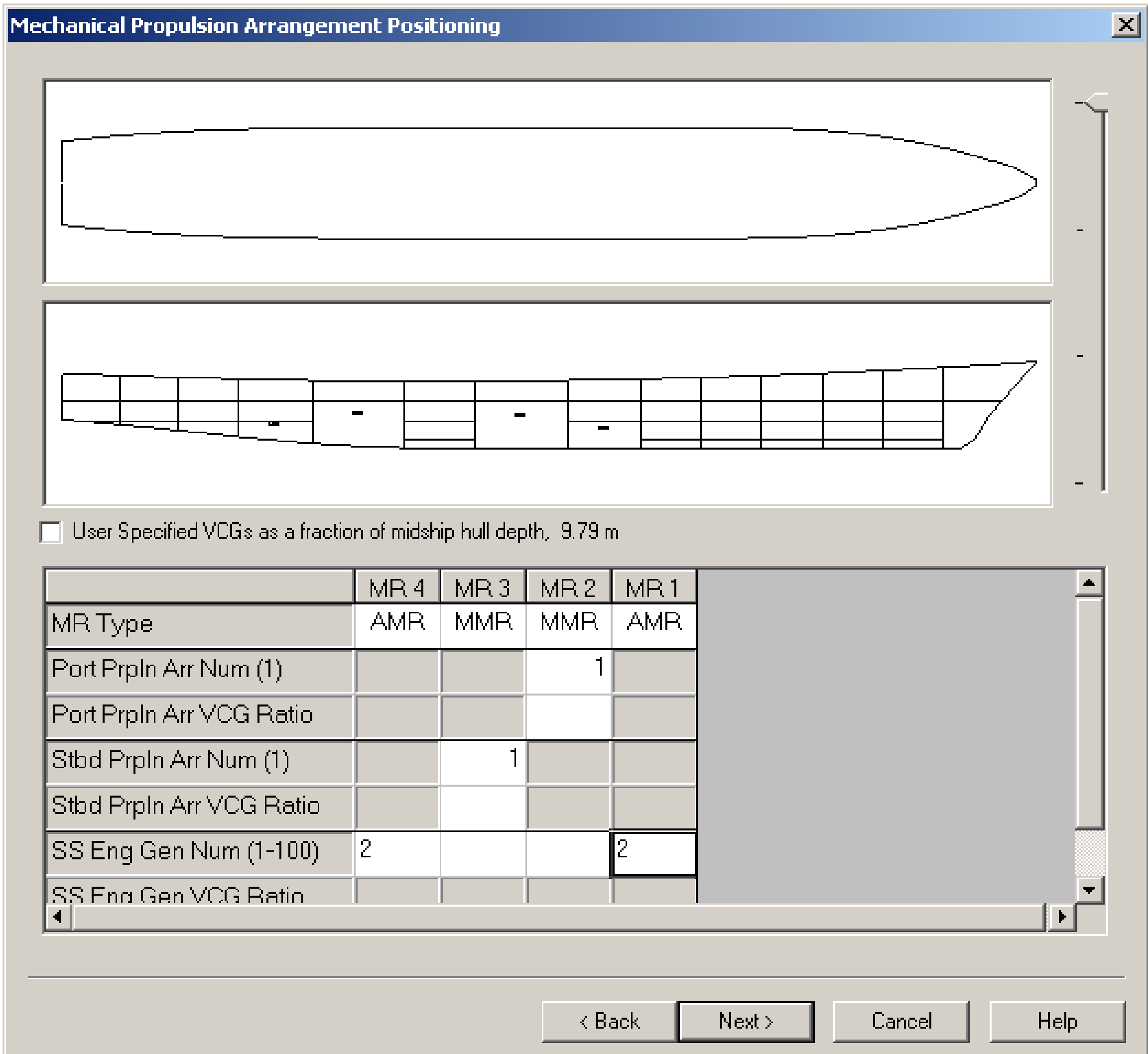
Ship Service KW Ratings--**CALCULATED BY MODULE: STANDARD**
Note that the associated text provides an explanation of the selected option.

Conventional Ship Service Engine Generator Set--**TYPE: DOMESTIC DIESEL ENGINE**

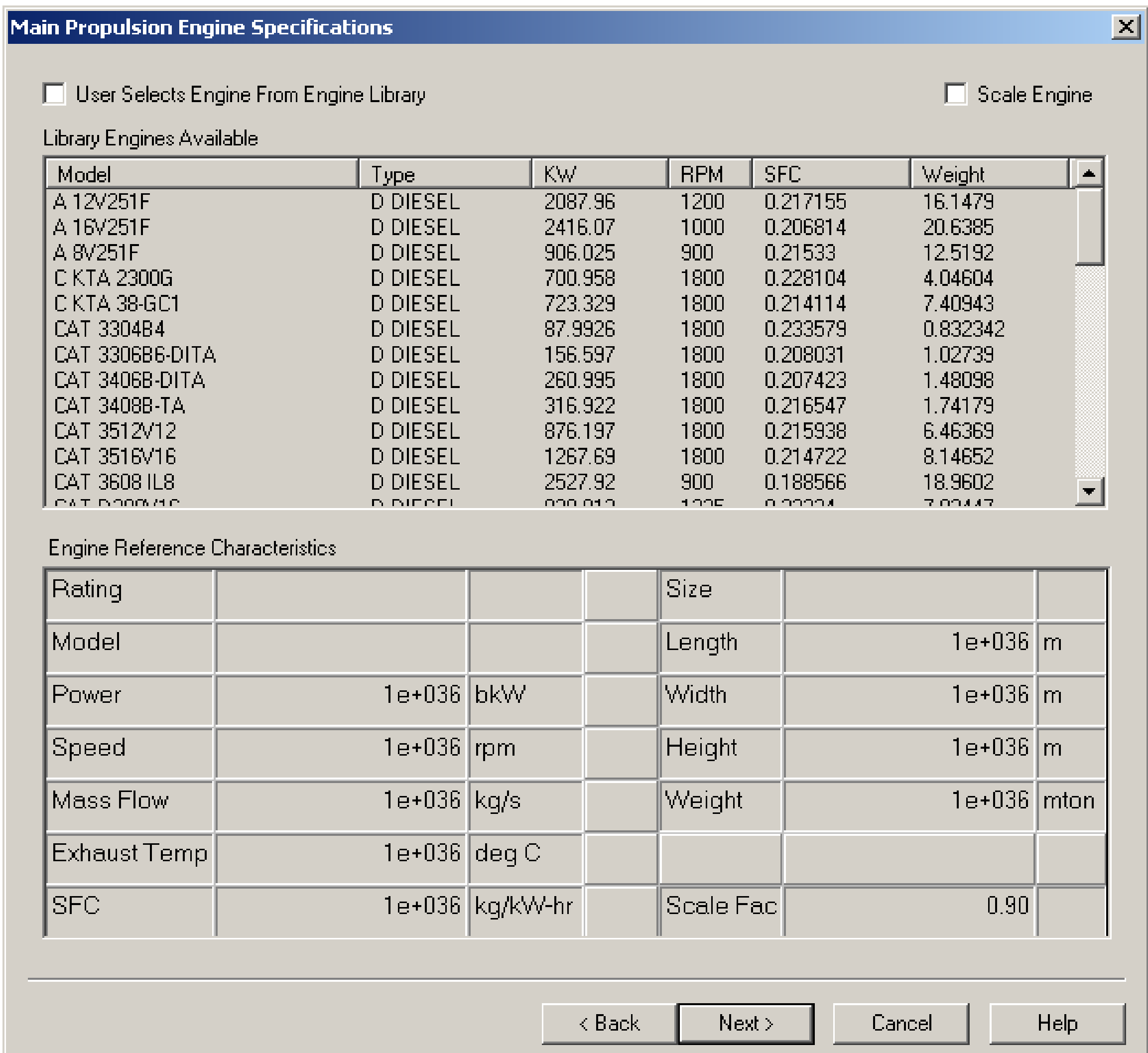
Because of the choices that were made in the design, you don't have to worry about putting in a particular power rating. ASSET will calculate the appropriate power levels. Since the design does not call for a propulsion-derived ship service system, you leave that particular block blank. After entering the data, click "Next" and the next window—the Propulsion Arrangement Selection—will appear:



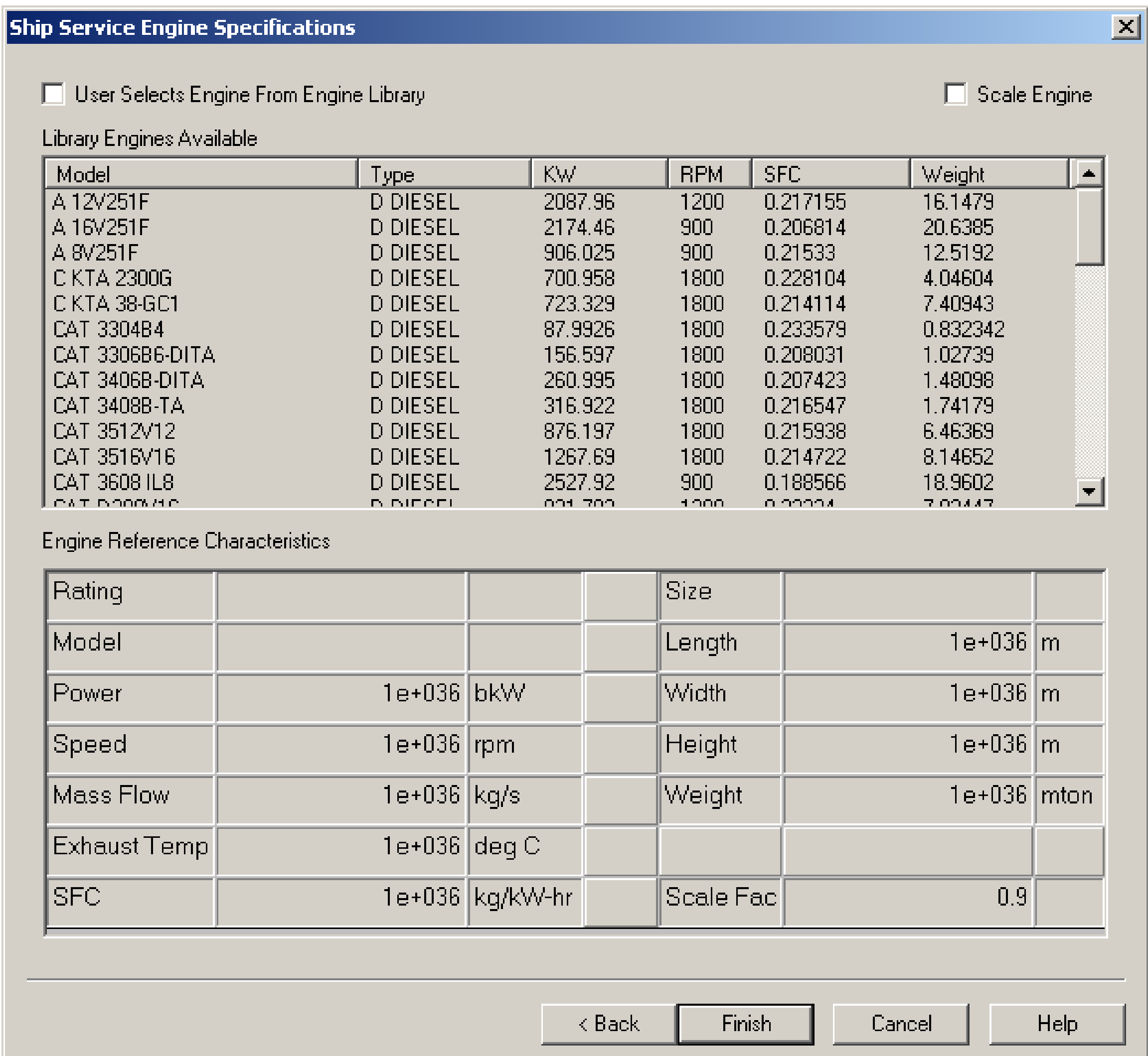
Since the design calls for the ship to have diesel engines and a controllable pitch propeller, the propulsion arrangement that best fits the ship is the **M2-HOSR**. This is two side-by-side main engines connected to a horizontal-offset, single-reduction gear. This arrangement has the reduction gear aft of the engine and connected to the propeller shaft. You will choose the **M2-HOSR** for the centerline/port shaft. After making the choice of the port engine, the next half of the window will ask you to choose the arrangement for the starboard shaft. Based on what was selected for the port shaft, the options available for the starboard shaft are limited. You should choose the **M2-HOSR/F**. This arrangement is identical to the port shaft except that the engines are turned so that the gear is located forward and the propeller shafts are "folded" back underneath the arrangement. The starboard shaft arrangement will be located in the aft MMR and this configuration will help reduce the shaft angle. After entering the data, click "Next" and the next window—the Propulsion Arrangement Positioning—will appear:



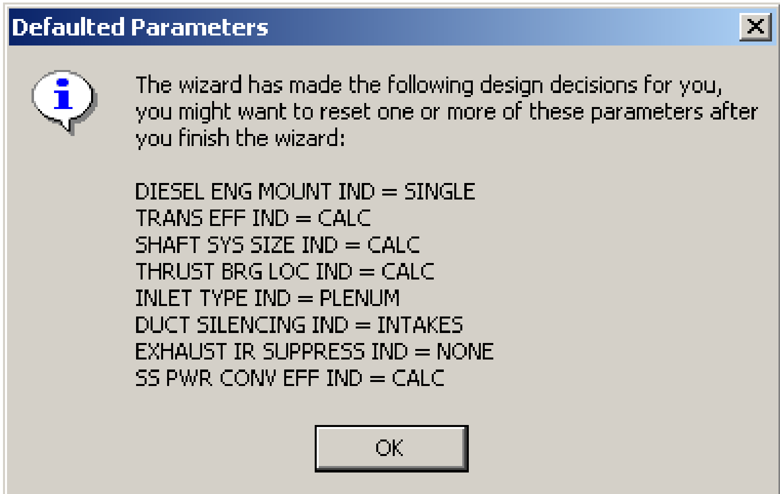
In this dialog, you will position each machinery arrangement in a machinery room. An inboard profile and deck plan has been imported from the Hull Subdivision Module to assist you. The first row shows the type and number of machinery rooms your design has. In the next row, you will specify where the Port Propulsion Arrangement is located (**PORT PRPLN ARR NUM (1)**). Each main machinery room will have one propulsion arrangement in it. Therefore, you should put **1** in the forward MMR and leave the aft MMR blank (the program assumes the blank cell to be zero). For the Starboard Propulsion Arrangement, the numbers are switched. That is, zero will go into the forward MMR and **1** will go in the aft MMR. Do not worry about the VCG ratios—ASSET will calculate them for the design. The last row you enter data in is the SS ENG GEN NUM. It has been determined that there are four (4) ship service engine generators (SSEGs), and two of them will go into each AMR. Therefore, you should input **2** SSEGs in the forward AMR and **2** SSEGs in the aft AMR. The two MMRs will have no SSEGs, and their cells will remain blank. After entering this data, click "Next" and the next window—the Main Propulsion Engine Specifications—will appear:



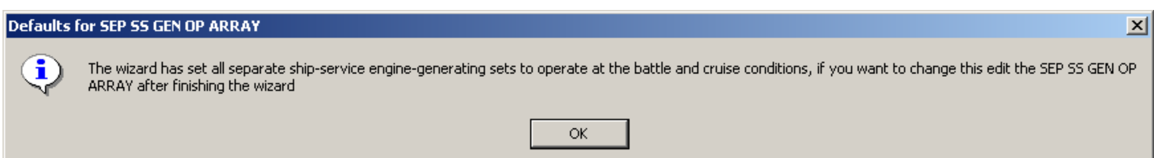
In this window, you may choose the specific engine model for the main propulsion engines. However, for your design, the box “User Selects Engine From Engine Library” should not be checked. This will instruct the Machinery Module to select an engine from the library of domestic diesel engines based on the horsepower required. Since no secondary propulsion system is part of this design, ASSET will skip the Secondary Propulsion Engine Specifications window. After clicking “Next”, the final window—the Ship Service Engine Specifications—will appear:



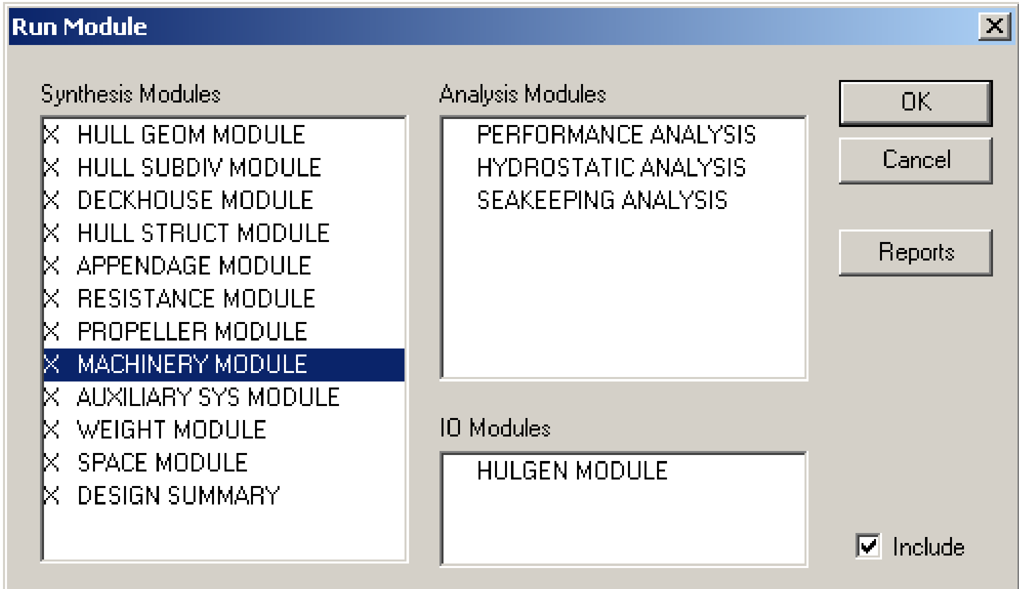
In this window, you may choose the model of the ship service engine for the design. As with the previous window, the box “User Selects Engine From Engine Library” should not be checked. The Machinery Module will select a domestic diesel engine from the library. After you click “Finish”, the following dialog box appears:



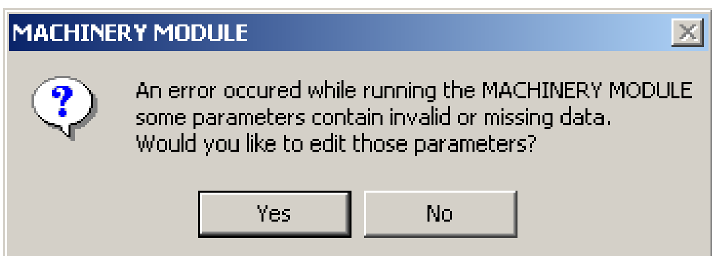
You will reset some of these parameters to have the design operate at sustained and endurance speed conditions. After clicking OK, the next dialog box appears:



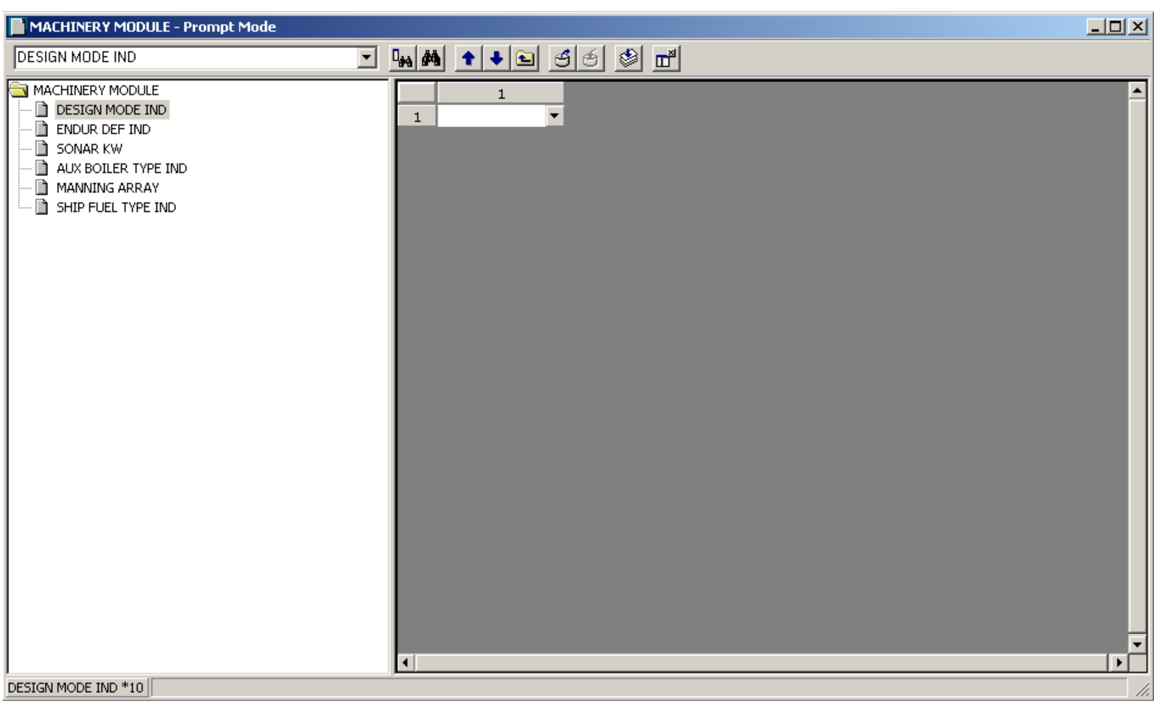
You will change the SEP SS GEN OP ARRAY to operate 3 generators at the battle and cruise conditions after you leave the Machinery Module Wizard. Normal U. S. Navy practice is to size the ship service generator sets to be able to provide all required electrical loads with one generator off-line. After clicking **OK**, you return to the Messages and Printed Reports windows of ASSET. Go to the Module menu and run the Machinery Module:



An error message appears after you give the command to run the module:



After clicking "Yes", ASSET takes you to the following editor prompt:



Enter the following values for each of the parameters:

DESIGN MODE IND: **ENDURANCE**

ENDUR DEF IND: **USN**

AUX BOILER TYPE IND: **ELECTRIC**

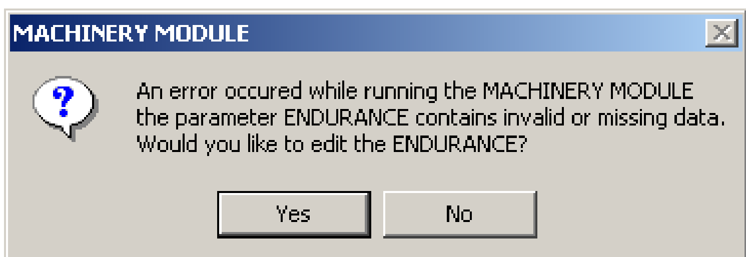
SONAR KW: Use **FRIGATE Ship Model Data** (see Section 6.10)

MANNING ARRAY: As described in Section 6.2.

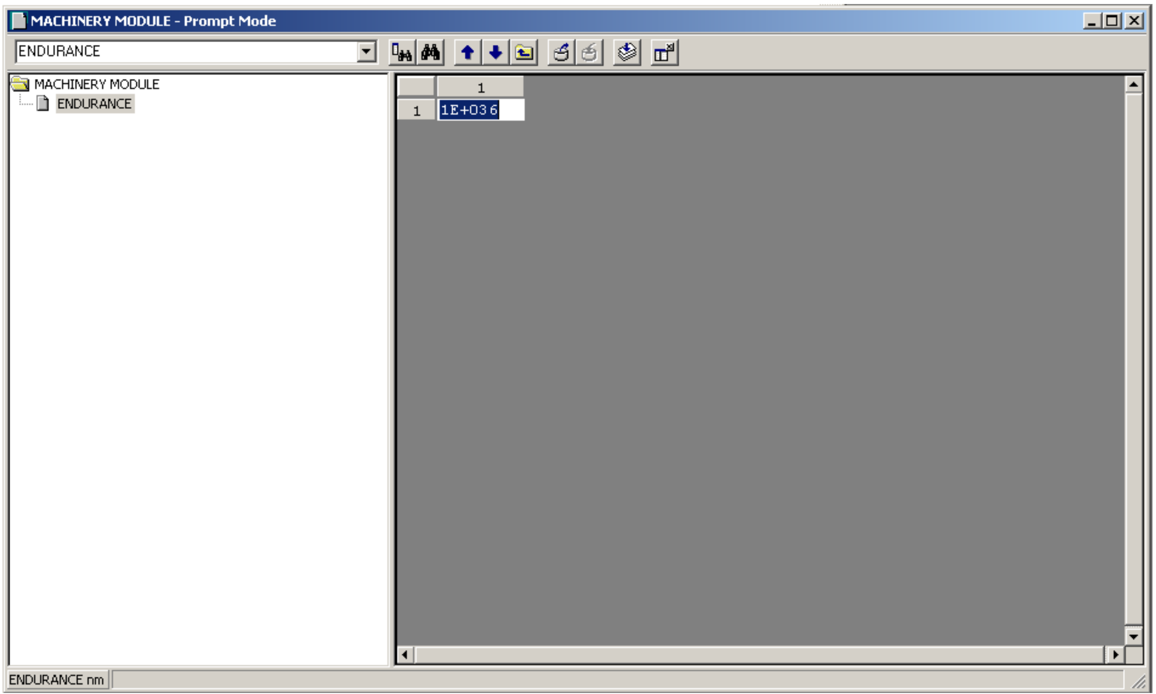
(Column 1: 12, 15, 140; Column 4: 6, 1, 13)

SHIP FUEL TYPE IND: **DFM**

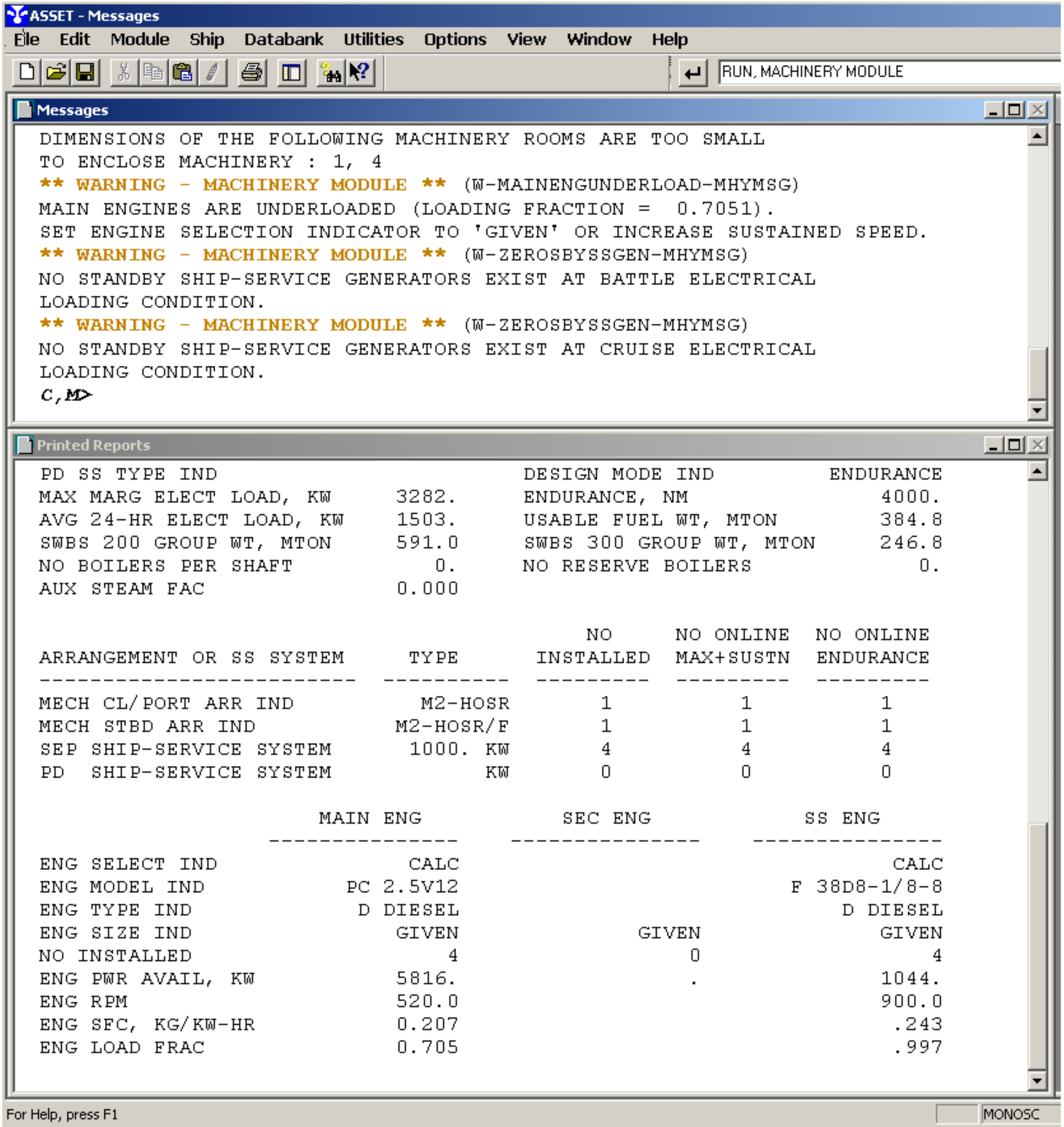
After inputting the data, get out of the Editor and save your changes. Rerun the Machinery Module and another error message will appear:



This is letting you know ASSET requires more information. After clicking OK, ASSET will take you to this Editor Prompt window:



Enter the Endurance value of **4000** nautical miles. This value comes from the Design Requirements. Save your changes and rerun the module. The Messages and Printed Reports windows will look like this:




```
DIMENSIONS OF THE FOLLOWING MACHINERY ROOMS ARE TOO SMALL
TO ENCLOSE MACHINERY : 1, 4
** WARNING - MACHINERY MODULE ** (W-MAINENGUNDERLOAD-MHYMSG)
MAIN ENGINES ARE UNDERLOADED (LOADING FRACTION =  0.7051).
SET ENGINE SELECTION INDICATOR TO 'GIVEN' OR INCREASE SUSTAINED SPEED.
** WARNING - MACHINERY MODULE ** (W-ZEROSBYSSGEN-MHYMSG)
NO STANDBY SHIP-SERVICE GENERATORS EXIST AT BATTLE ELECTRICAL
LOADING CONDITION.
** WARNING - MACHINERY MODULE ** (W-ZEROSBYSSGEN-MHYMSG)
NO STANDBY SHIP-SERVICE GENERATORS EXIST AT CRUISE ELECTRICAL
LOADING CONDITION.
C,M>
```

Printed Reports

```
PD SS TYPE IND                         DESIGN MODE IND          ENDURANCE
MAX MARG ELECT LOAD, KW     3282.      ENDURANCE, NM                4000.
AVG 24-HR ELECT LOAD, KW    1503.      USABLE FUEL WT, MTON         384.8
SWBS 200 GROUP WT, MTON     591.0      SWBS 300 GROUP WT, MTON      246.8
NO BOILERS PER SHAFT           0.      NO RESERVE BOILERS              0.
AUX STEAM FAC               0.000

                                            NO      NO ONLINE  NO ONLINE
ARRANGEMENT OR SS SYSTEM      TYPE      INSTALLED  MAX+SUSTN  ENDURANCE
------------------------  ----------  ---------  ---------  ---------
MECH CL/PORT ARR IND         M2-HOSR        1          1          1
MECH STBD ARR IND          M2-HOSR/F        1          1          1
SEP SHIP-SERVICE SYSTEM     1000. KW        4          4          4
PD  SHIP-SERVICE SYSTEM           KW        0          0          0

                     MAIN ENG           SEC ENG            SS ENG
                 ---------------   ---------------   ---------------
ENG SELECT IND              CALC                                CALC
ENG MODEL IND          PC 2.5V12                       F 38D8-1/8-8
ENG TYPE IND            D DIESEL                            D DIESEL
ENG SIZE IND               GIVEN             GIVEN             GIVEN
NO INSTALLED                   4                 0                 4
ENG PWR AVAIL, KW          5816.                 .             1044.
ENG RPM                    520.0                               900.0
ENG SFC, KG/KW-HR          0.207                                .243
ENG LOAD FRAC              0.705                                .997
```

Now you will edit the module to change parameters that fit the ship's design better. Get into the Editor and change the following parameters to these values:

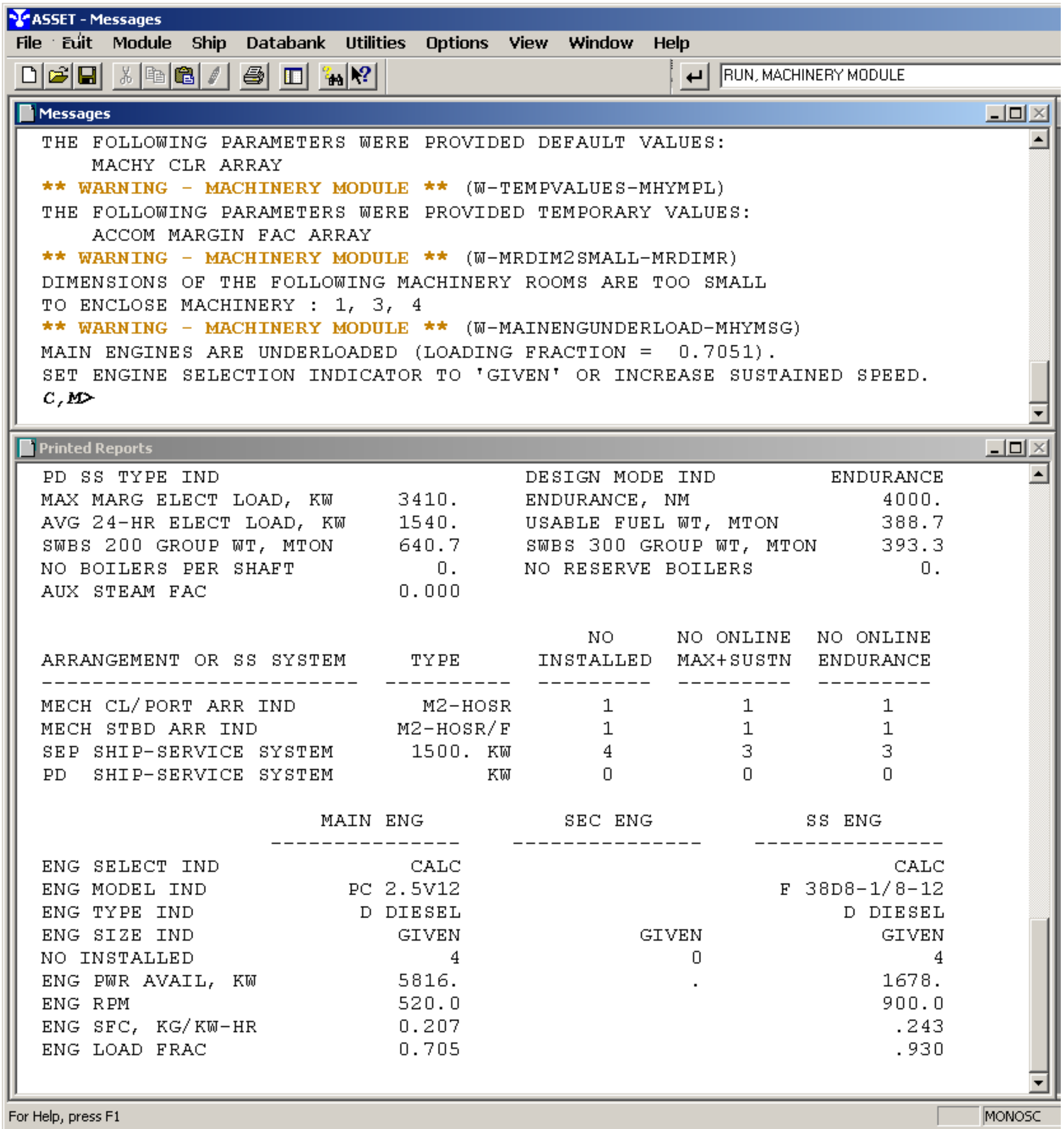
DUCT SILENCING IND: **NONE**

SEP SS GEN OP ARRAY: **3** on-line generators for each condition

DIESEL ENG MOUNT IND: **COMPOUND**

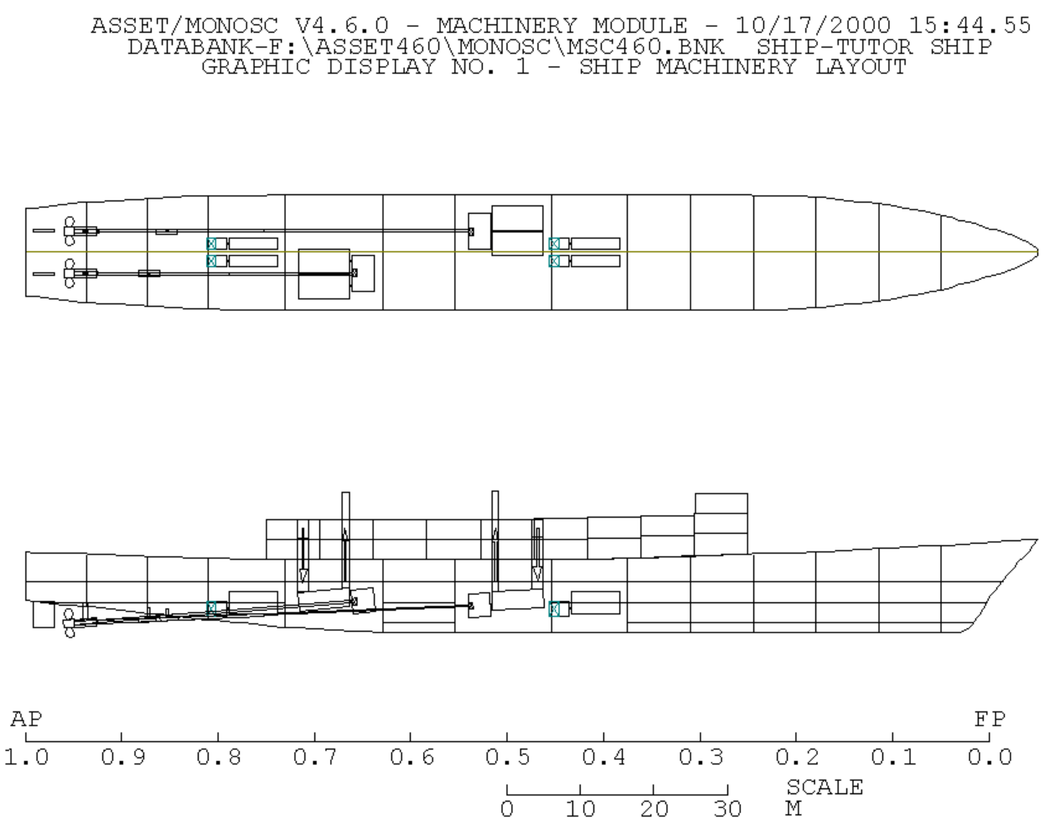
HULL CLR ARRAY: **1** meter for each direction

Get out of the Editor and save your changes. Rerun the module. The new Messages and Printed Reports windows look like this:

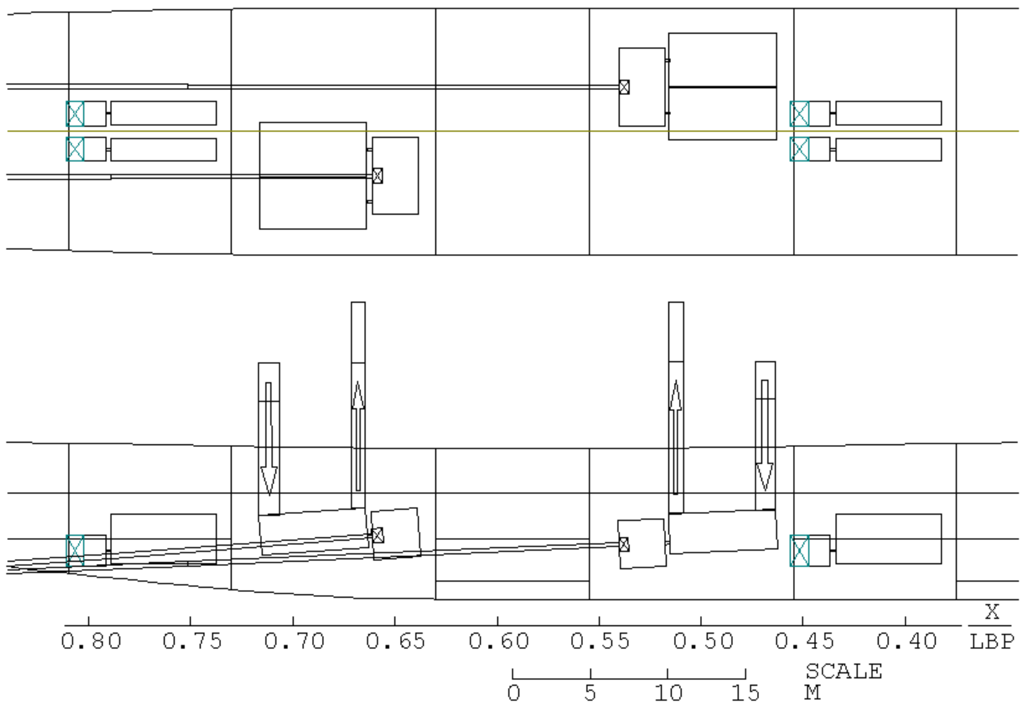


In the Machinery Box graphic, notice the positioning of the engines. ASSET defaulted to machinery KG since you selected CALC for that parameter. Now that you know where ASSET placed the engines, you can better estimate their position. Go into the Editor (**Edit⇒Open Editor**) and type "ARRANGEMENT CG" in the parameter box. Click the **Jump To** button to be taken to the ARRANGEMENT CG parameter. Set the MACHY

KG IND to **GIVEN**. With this set to **GIVEN**, you are now responsible for entering the KG of the main and ship service engines. Type "MAIN ENG KG ARRAY" in the parameter box and click the **Jump To** button to go to this parameter. Set the main engine KG to **0.40** and **0.45** for the forward and aft engines, respectively. Type "SS ENG KG ARRAY" and click the **Jump To** button to go to this parameter. Set the ship service engine KG to **0.35** and **0.45** for the forward and aft engines, respectively. (Use on-line help for clarification on these parameters.) Rerun the module and observe the results. Save your module run (**Ship⇒Modify**). Following are the Summary printed report and the Ship Layout and the Machinery Box graphic reports (reports #1 and #2).



ASSET/MONOSC V4.6.0 - MACHINERY MODULE - 10/17/2000 15:44.55
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 2 - MACHINERY BOX

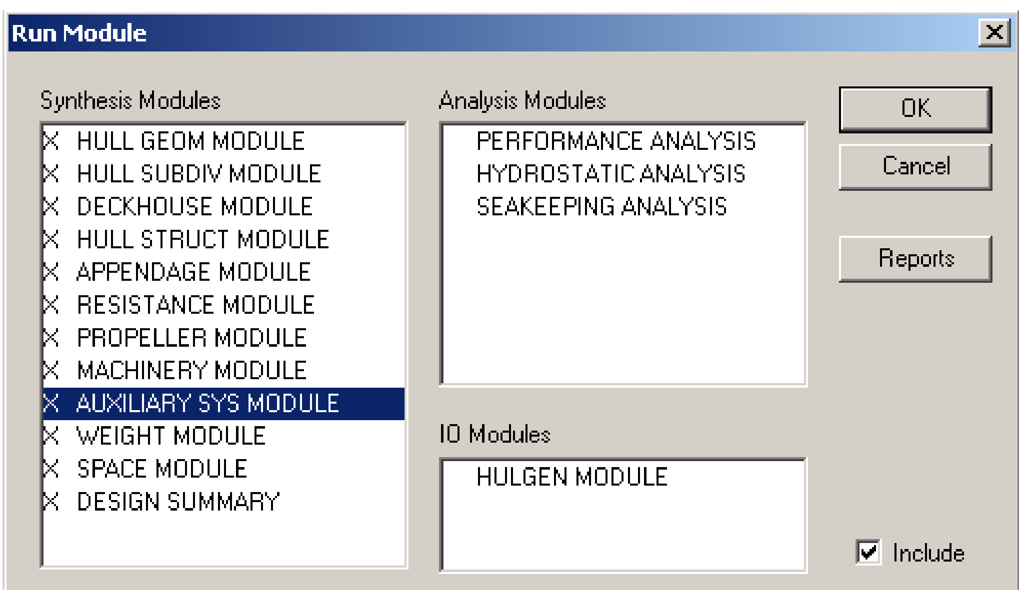



```
      ASSET/MONOSC V4.6.0 - MACHINERY MODULE - 10/17/2000 15:46.32
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

PRINTED REPORT NO. 1 - SUMMARY

TRANS TYPE IND                 MECH     MAX SPEED, KT                25.39
ELECT PRPLN TYPE IND                    SUSTN SPEED IND              GIVEN
SHAFT SUPPORT TYPE IND OPEN STRUT       SUSTN SPEED, KT              24.00
NO PROP SHAFTS                   2.     SUSTN SPEED POWER FRAC       0.800
SEC ENG USAGE IND                       ENDUR SPEED IND              GIVEN
SS SYS TYPE IND                 SEP     ENDUR SPEED, KT              18.00
PD SS TYPE IND                          DESIGN MODE IND          ENDURANCE
MAX MARG ELECT LOAD, KW       3410.     ENDURANCE, NM                4000.
AVG 24-HR ELECT LOAD, KW      1540.     USABLE FUEL WT, MTON         388.7
SWBS 200 GROUP WT, MTON       640.7     SWBS 300 GROUP WT, MTON      393.3
NO BOILERS PER SHAFT             0.     NO RESERVE BOILERS              0.
AUX STEAM FAC                 0.000

                                                NO     NO ONLINE  NO ONLINE
ARRANGEMENT OR SS SYSTEM       TYPE       INSTALLED  MAX+SUSTN  ENDURANCE
-------------------------  ----------   ---------  ---------  ---------
MECH CL/PORT ARR IND          M2-HOSR         1          1          1
MECH STBD ARR IND           M2-HOSR/F         1          1          1
SEP SHIP-SERVICE SYSTEM     1500. KW          4          3          3
PD  SHIP-SERVICE SYSTEM           KW          0          0          0

                       MAIN ENG            SEC ENG            SS ENG
                    ---------------    ---------------    ---------------
```

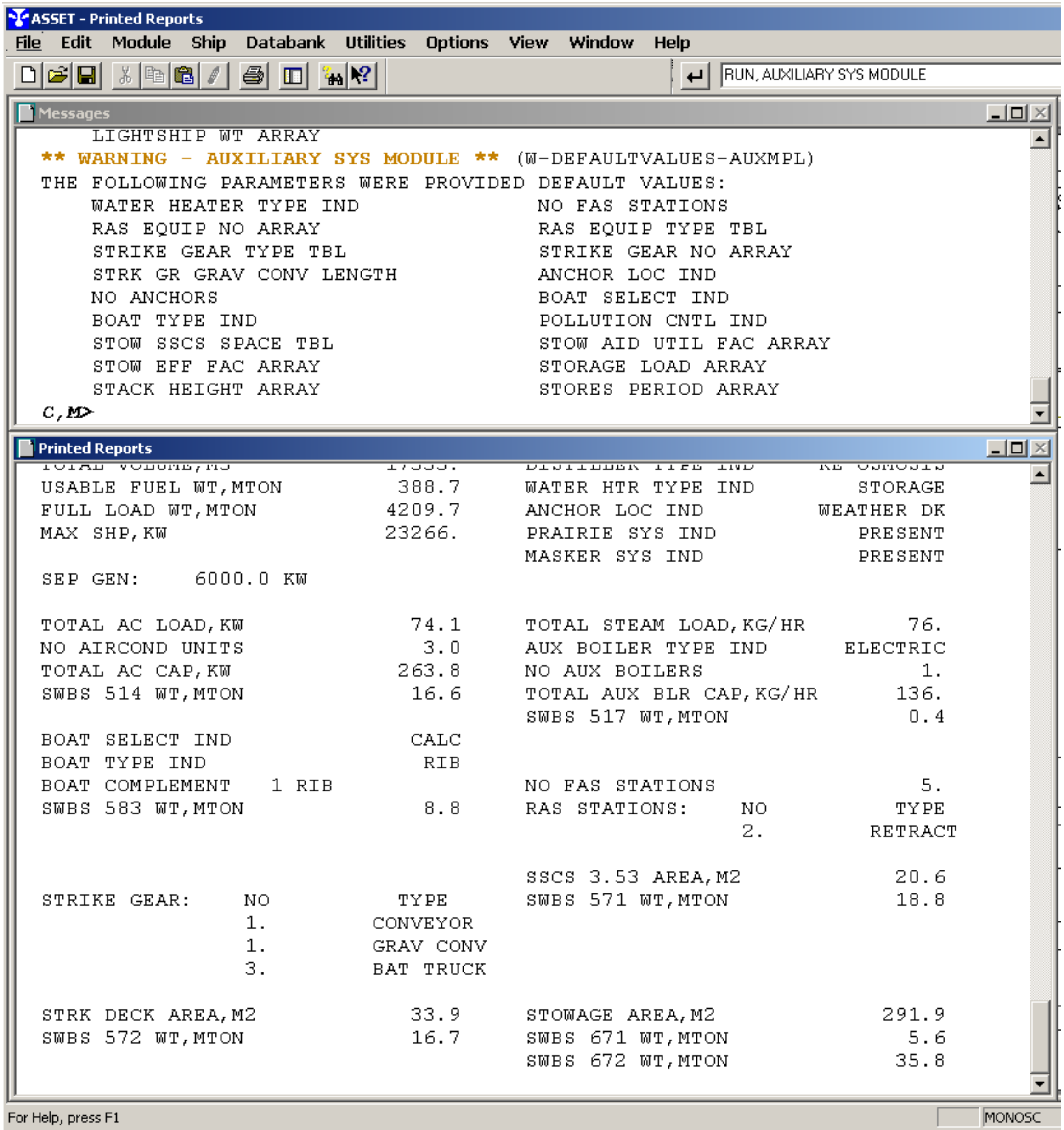
ENG SELECT IND	CALC		CALC
ENG MODEL IND	PC 2.5V12		F 38D8-1/8-12
ENG TYPE IND	D DIESEL		D DIESEL
ENG SIZE IND	GIVEN	GIVEN	GIVEN
NO INSTALLED	4	0	4
ENG PWR AVAIL, KW	5816.	.	1678.
ENG RPM	520.0		900.0
ENG SFC, KG/KW-HR	0.207		.243
ENG LOAD FRAC	0.705		.930

6.14 AUXILIARY SYSTEMS MODULE

The Auxiliary Systems module calculates weights and centers of gravity for the ship's auxiliary systems. The systems include air conditioning, auxiliary boilers, boats, replenishment systems, strikedown gear, and stowage systems. After selecting Run from the Module menu, you will see this dialog box:



You notice that ASSET does not need any information for this module. The Messages and Printed Reports window will look like this:

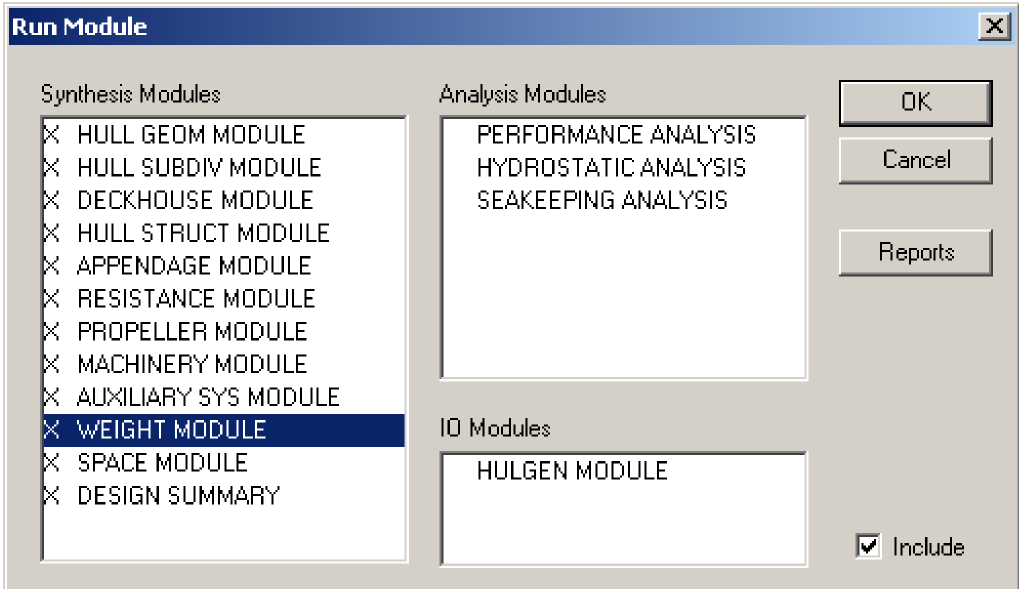


Everything seems OK for now. All of the defaults are based on either ship size or manning. If the ship changes significantly in either of these areas, the default parameters will be in error. Later in the design, you may want to allow ASSET to generate new default values based on the new design. Following is the Summary printed report. The Auxiliary Systems module does not generate any graphics.

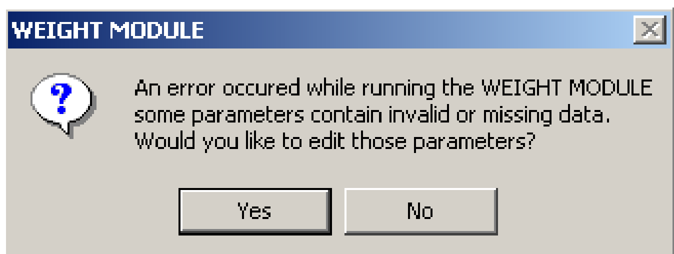
```
    ASSET/MONOSC V4.6.0 - AUXILIARY SYS MODULE - 10/17/2000 15:54. 5
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO. 1 - SUMMARY

 LBP,M                        131.0     TOTAL ACCOM                  187.0
 BEAM,M                        14.0     COLL PROT SYS IND          PRESENT
 TOTAL AREA,M2                4071.     COMP HTR TYPE IND         ELECTRIC
 TOTAL VOLUME,M3             17335.     DISTILLER TYPE IND      RE OSMOSIS
 USABLE FUEL WT,MTON          388.7     WATER HTR TYPE IND         STORAGE
 FULL LOAD WT,MTON           4209.7     ANCHOR LOC IND          WEATHER DK
 MAX SHP,KW                  23266.     PRAIRIE SYS IND            PRESENT
                                        MASKER SYS IND             PRESENT
 SEP GEN:    6000.0 KW

 TOTAL AC LOAD,KW              74.1     TOTAL STEAM LOAD,KG/HR         76.
 NO AIRCOND UNITS               3.0     AUX BOILER TYPE IND       ELECTRIC
 TOTAL AC CAP,KW              263.8     NO AUX BOILERS                  1.
 SWBS 514 WT,MTON              16.6     TOTAL AUX BLR CAP,KG/HR       136.
                                        SWBS 517 WT,MTON               0.4
 BOAT SELECT IND               CALC
 BOAT TYPE IND                  RIB
 BOAT COMPLEMENT   1 RIB                NO FAS STATIONS                 5.
 SWBS 583 WT,MTON               8.8     RAS STATIONS:    NO           TYPE
                                                         2.
RETRACT

                                        SSCS 3.53 AREA,M2             20.6
 STRIKE GEAR:    NO            TYPE     SWBS 571 WT,MTON              18.8
                 1.        CONVEYOR
                 1.        GRAV CONV
                 3.        BAT TRUCK

 STRK DECK AREA,M2             33.9     STOWAGE AREA,M2              291.9
 SWBS 572 WT,MTON              16.7     SWBS 671 WT,MTON               5.6
                                        SWBS 672 WT,MTON              35.8
```

6.15 WEIGHT MODULE

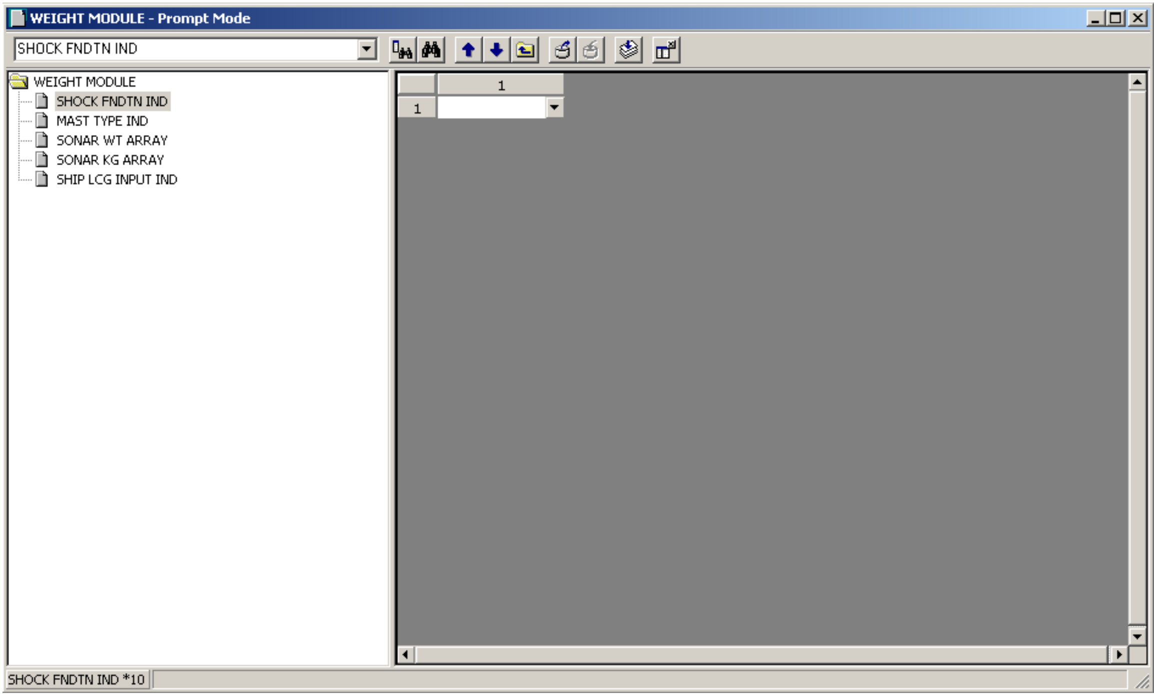
This module calculates a detailed weight breakdown for the ship. Other modules have already calculated most of the weight and centers data. The Weight Module estimates the remaining groups and then sums and reports all weight data. After selecting **Run** from the Module menu, the following dialog box appears:



After selecting the Weight Module, ASSET returns with the following:



After clicking “Yes”, the Weight Module Editor Prompt appears:



Read the on-line help for information about each parameter. Enter the following values for each parameter:

SHOCK FNDTN: **SHOCK**

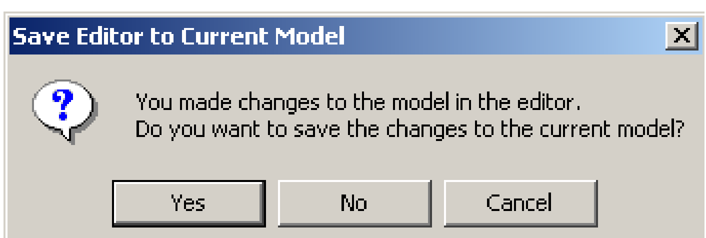
MAST TYPE IND: **MAST**

SONAR WT ARRAY: Use **FRIGATE** Ship Data (See Section 6.10)

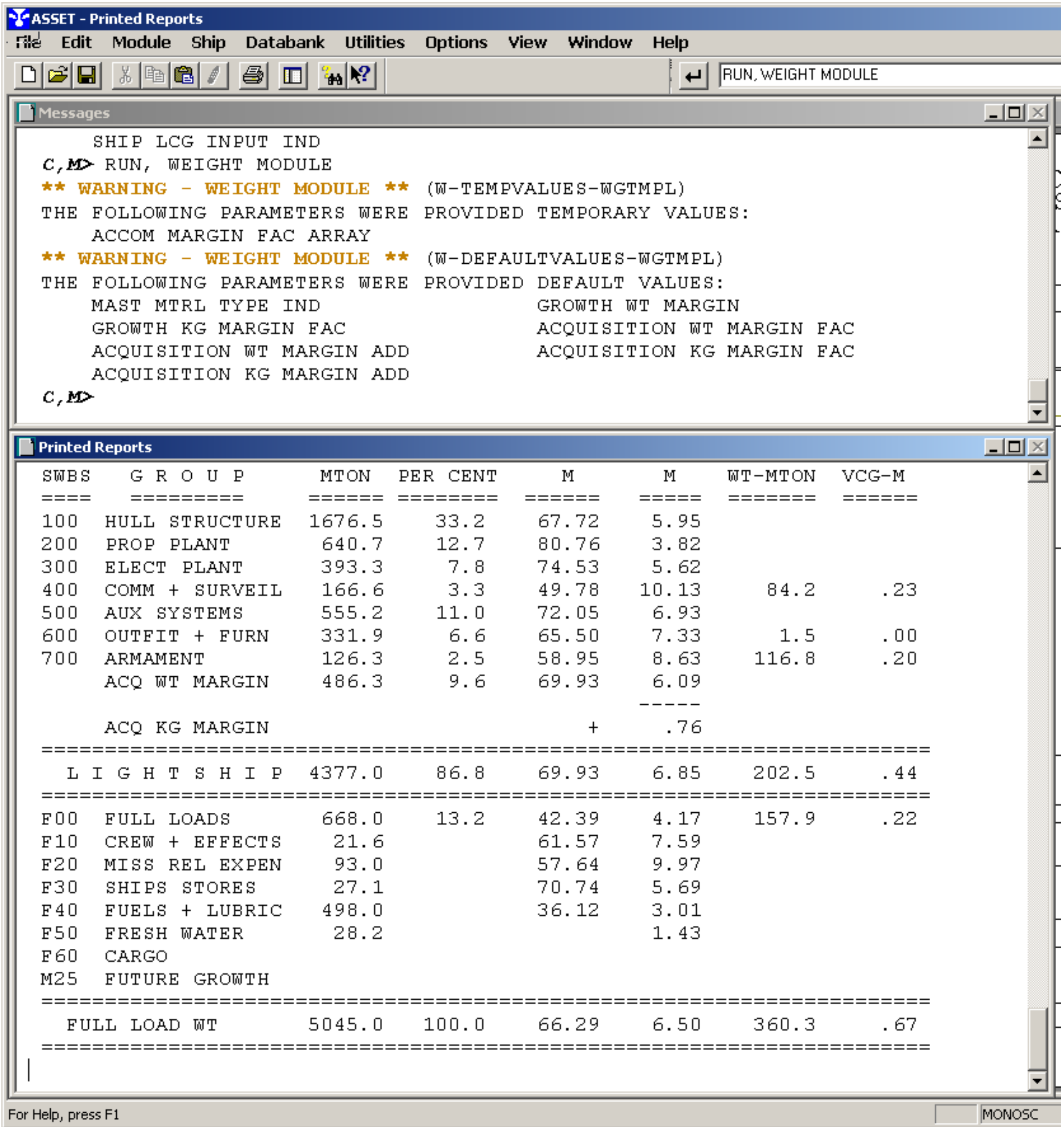
SONAR KG ARRAY: Use **FRIGATE** Ship Data

SHIP LCG INPUT IND: **CALC**

After entering this data, the Save Editor in Current Module dialog box appears:



After clicking "Yes", ASSET will rerun the Weight Module. The Messages and Printed Reports windows will look like this:

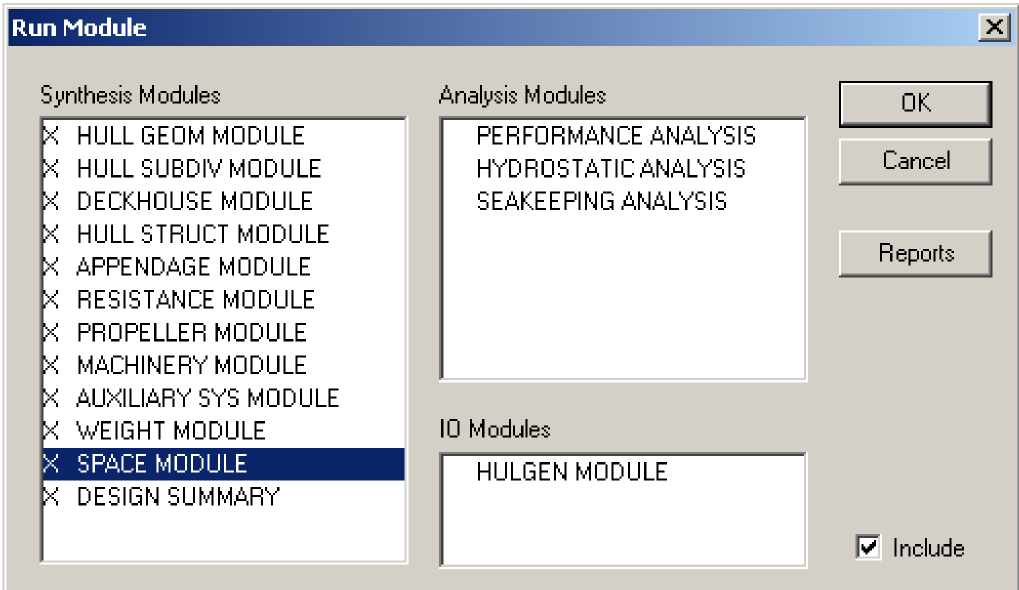


The input for the module is complete. The Weight Module has defaulted several parameters. You should verify that these are appropriate for your design. The Weight Module Summary printed report follows. Additional reports provide weight and centers data at the SWBS 3-digit level. Save the results of this module **(Ship⇒Modify)**.

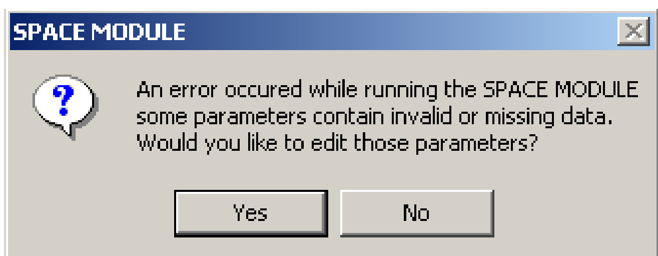
```
       ASSET/MONOSC V4.6.0 - WEIGHT MODULE - 10/17/2000 16: 6. 6
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO.  1 - SUMMARY

                         W E I G H T      LCG      VCG    RESULTANT ADJ
 SWBS   G R O U P       MTON  PER CENT     M        M    WT-MTON  VCG-M
 ====   =========      ====== ========  ======   =====  =======  ======
 100  HULL STRUCTURE  1676.5    33.2    67.72    5.95
 200  PROP PLANT       640.7    12.7    80.76    3.82
 300  ELECT PLANT      393.3     7.8    74.53    5.62
 400  COMM + SURVEIL   166.6     3.3    49.78   10.13     84.2     .23
 500  AUX SYSTEMS      555.2    11.0    72.05    6.93
 600  OUTFIT + FURN    331.9     6.6    65.50    7.33      1.5     .00
 700  ARMAMENT         126.3     2.5    58.95    8.63    116.8     .20
      ACQ WT MARGIN    486.3     9.6    69.93    6.09
                                                -----
      ACQ KG MARGIN                         +     .76
 ======================================================================
   L I G H T S H I P  4377.0    86.8    69.93    6.85    202.5     .44
 ======================================================================
 F00  FULL LOADS       668.0    13.2    42.39    4.17    157.9     .22
 F10  CREW + EFFECTS    21.6            61.57    7.59
 F20  MISS REL EXPEN    93.0            57.64    9.97
 F30  SHIPS STORES      27.1            70.74    5.69
 F40  FUELS + LUBRIC   498.0            36.12    3.01
 F50  FRESH WATER       28.2                     1.43
 F60  CARGO
 M25  FUTURE GROWTH
 ======================================================================
   FULL LOAD WT       5045.0   100.0    66.29    6.50    360.3     .67
 ======================================================================
```

6.16 SPACE MODULE

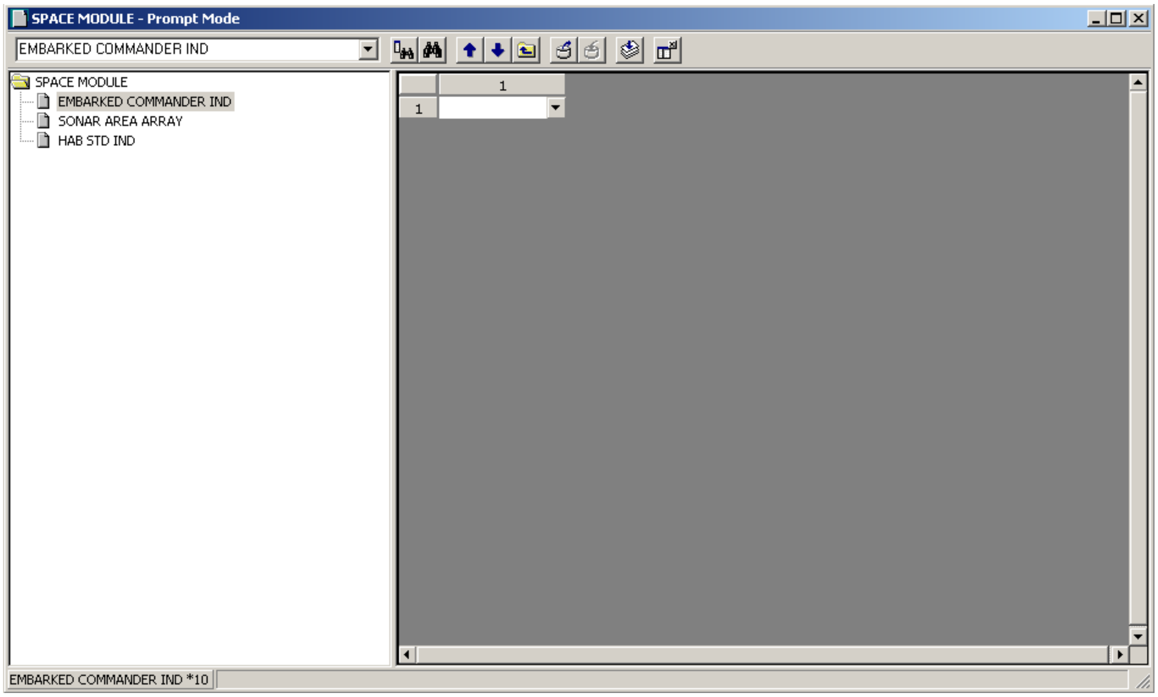
This module calculates the total arrangeable area and volume requirements of the ship. The Space Module functions similar to the Weight Module in that it collects area and volume requirements calculated by other modules and then estimate requirements for the remaining groups. The Space Module uses the Ship Space Classification System (SSCS) to input area and volume requirements. After selecting **Run** from the Module menu, the following dialog box appears:



After selecting the Space Module, click “OK” and ASSET returns with the following dialog box:



After clicking “Yes”, the Space Module Editor Prompt window appears:



Read the on-line help for information concerning the parameters. Enter the following values for each parameter:

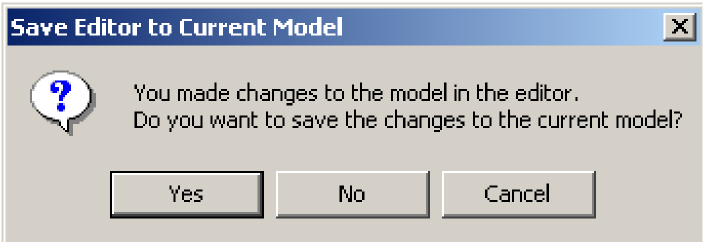
EMBARKED COMMANDER IND: **NONE**

SONAR AREA ARRAY: Use **FRIGATE** Ship Data (See Section 6.10)

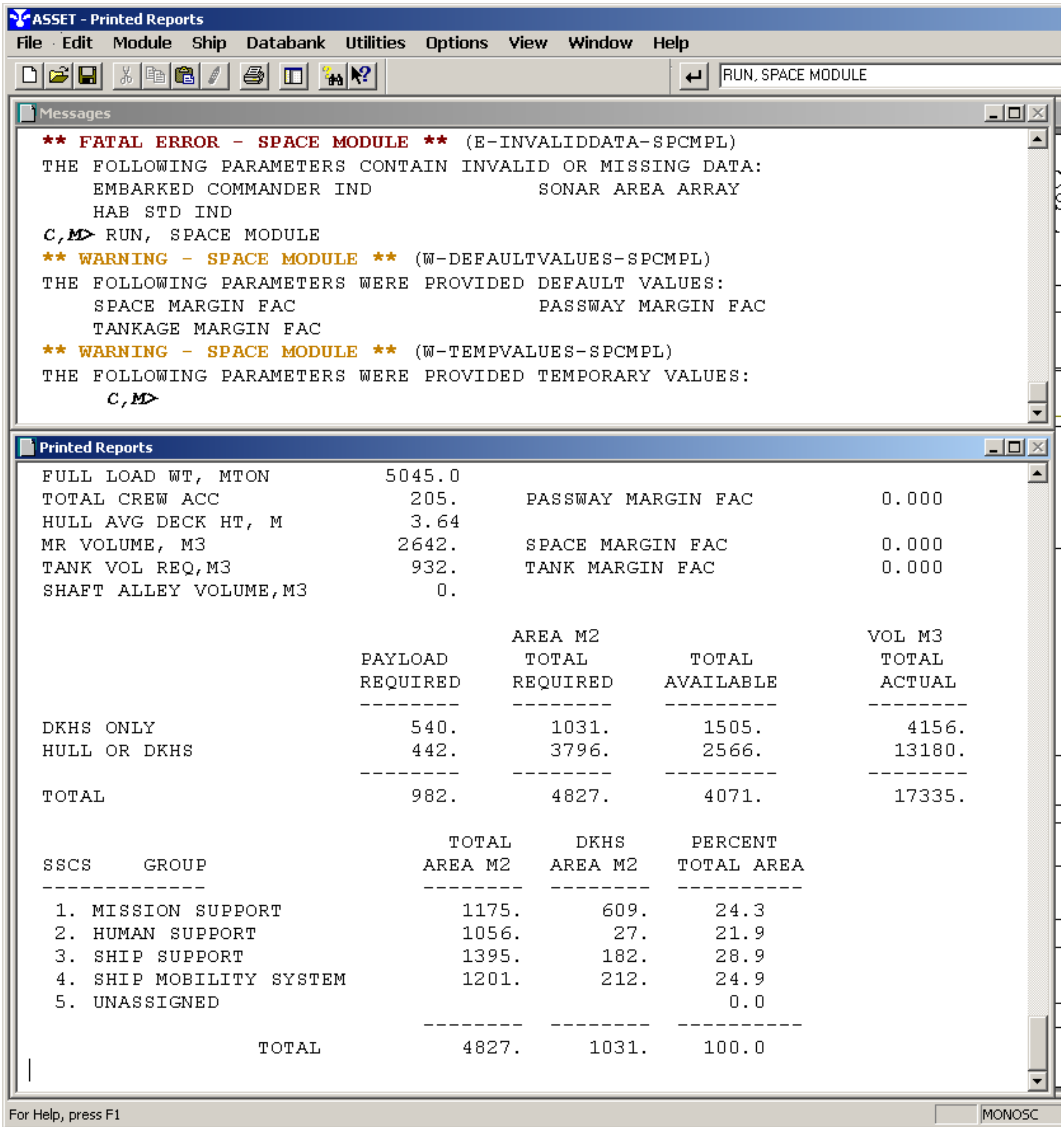
HAB STD IND: **NAVY**

Note: The value **MINOR AVN** was chosen in the AVIATION FACILITIES IND because your design has helicopter facilities.

After entering the data, click the **Run** button in the Editor. The Save Editor to Current Module dialog box appears:



After clicking "Yes", the module runs again. ASSET returns with the Messages and Printed Report windows:



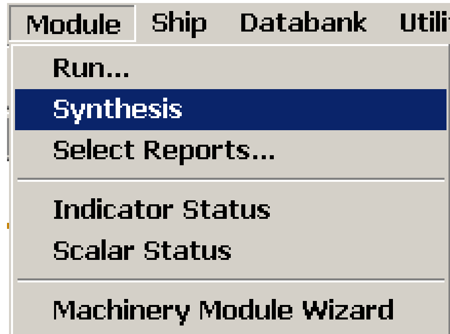
Your design should have a space and tankage margin factor of 0.05. Read the on-line help for clarification of the SPACE MARGIN FAC and TANKAGE MARGIN FAC parameters. Go into the Editor and set both of these parameters to **0.05** and run the Space Module again. Following is the summary printed report. Be sure to save this module (**Ship⇒Modify**).

```
        ASSET/MONOSC V4.6.0 - SPACE MODULE - 10/17/2000 16:17.22
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO.  1 - SUMMARY

 SHIP TYPE-SC                                 AVIATION FACILITY-MINOR AVN
 COLL PROTECT SYSTEM-PRESENT                  HAB STANDARD-NAVY
 SONAR DOME-PRESENT                           EMBARKED COMMANDER-NONE

 FULL LOAD WT, MTON          5045.0
 TOTAL CREW ACC                205.     PASSWAY MARGIN FAC           0.000
 HULL AVG DECK HT, M           3.64
 MR VOLUME, M3                2642.     SPACE MARGIN FAC             0.050
 TANK VOL REQ,M3               978.     TANK MARGIN FAC              0.050
 SHAFT ALLEY VOLUME,M3           0.

                                           AREA M2                   VOL M3
                           PAYLOAD      TOTAL        TOTAL            TOTAL
                           REQUIRED    REQUIRED    AVAILABLE
ACTUAL
                           --------    --------    ---------         ------
--
 DKHS ONLY                     540.       1082.       1505.
4156.
 HULL OR DKHS                  442.       3986.       2566.
13180.
                           --------    --------    ---------         ------
--
 TOTAL                         982.       5068.       4071.
17335.

                                       TOTAL     DKHS     PERCENT
 SSCS    GROUP                       AREA M2   AREA M2   TOTAL AREA
 -------------                       --------  --------  ----------
  1. MISSION SUPPORT                    1175.      609.     23.2
  2. HUMAN SUPPORT                      1056.       27.     20.8
  3. SHIP SUPPORT                       1395.      182.     27.5
  4. SHIP MOBILITY SYSTEM               1201.      212.     23.7
  5. UNASSIGNED                         241.3      51.5      4.8
                                     --------  --------  ----------
                 TOTAL                  5068.     1082.    100.0
```

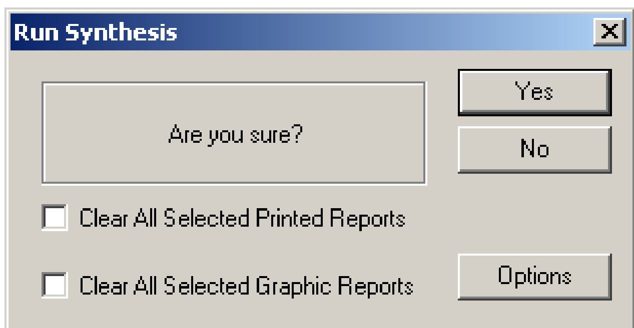
6.17 SYNTHESIS

With the completion of the Space module, you are now ready to send your model to synthesis. The synthesis process in ASSET will run each of the modules in series and then continue to iterate through the modules until all the design parameters converge and your model is coherent in all respects. Before you begin, you will need to check a few items.

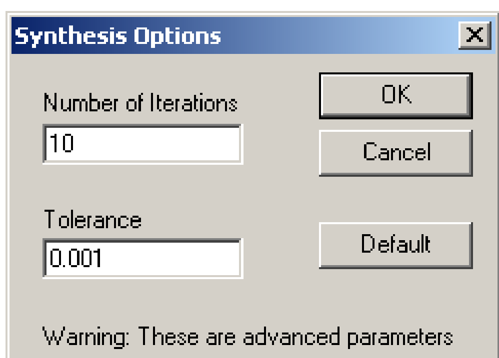
From the Module menu select Synthesis:



Once Synthesis is selected, you will see the following dialog box:



Click on the *Options* button on the pop-up form.



With this dialog box, you are able to set the number of iterations in the synthesis loop. If you select a smaller tolerance, ASSET will need more iterations to converge the model. Set the iterations to **15**. Press the OK button.

Run Synthesis by pressing the **Yes** button on the RUN SYNTHESIS dialog. After you issue this command, ASSET begins the synthesis process.

You should note that when running Synthesis, BEAM will be changed to provide the specified GMT/B REQ and required arrangeable area.

Most ships should converge in about 6 to 8 iterations. If the model has not converged after 15 iterations, run Synthesis again. If the model has not converged in 30 iterations, the hull geometry is probably oscillating between two very close configurations.

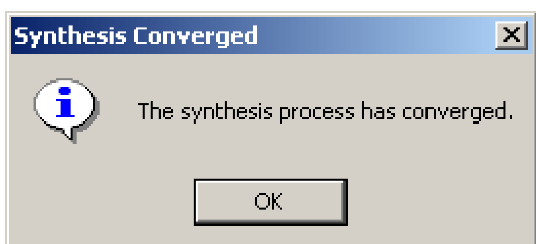
The primary hull geometry culprit for oscillation is BEAM. The BEAM is adjusted to satisfy the GMT/B REQ. However, BEAM affects several parameters that affect the KG, which in turn affects GMT. A subtle shift in BEAM can produce a big enough change in KG that the change in GMT exceeds the synthesis tolerance. Then the Hull Geometry Module, to satisfy the GMT/B REQ, may reverse the previous adjustment to BEAM. For example, let's assume that in the current iteration the GMT/B is too high. To correct this the Hull Geometry Module will decrease BEAM. Generally this will result in a proportionally higher reduction in KMT and therefore a reduction in GMT/B, assuming KG is unchanged. However, the reduction in BEAM may allow the Hull Structure Module to reduce the thickness of the bottom shell plating. This will result in an increase in KG and may cause the GMT/B to be lower than required. On the next synthesis iteration, the Hull Geometry Module will increase BEAM to satisfy the GMT/B REQ. Then the Hull Structure Module due to the increased BEAM may increase the thickness of the bottom shell plating, resulting in a decrease in KG. If the newly calculated BEAM and resulting KG are close to the values obtained two iterations before, an oscillation has begun.

If you suspect an oscillation in hull geometry, set the number of synthesis iterations to 1. Then run Synthesis. By checking BEAM and other characteristics after each of several runs through synthesis you can determine if an oscillation is occurring and the range of oscillation.

To correct for a failure to converge due to oscillation, change the HULL DIM IND to eliminate the variable from the hull geometry calculations and set the hull geometry within the range of the oscillation. Thus if BEAM is oscillating set the HULL DIM IND value to **T** and set BEAM to a reasonable value within the oscillation range. Generally, this range is extremely small. After fixing the hull geometry, the Synthesis process should be able to converge the model.

In many cases, changes in DRAFT (T) can have a more significant impact on convergence than BEAM. Another option is to set DRAFT to a reasonable value within the oscillating range and set the HULL DIM IND equal to BEAM.

After the synthesis converges, ASSET returns with a message similar to the following.



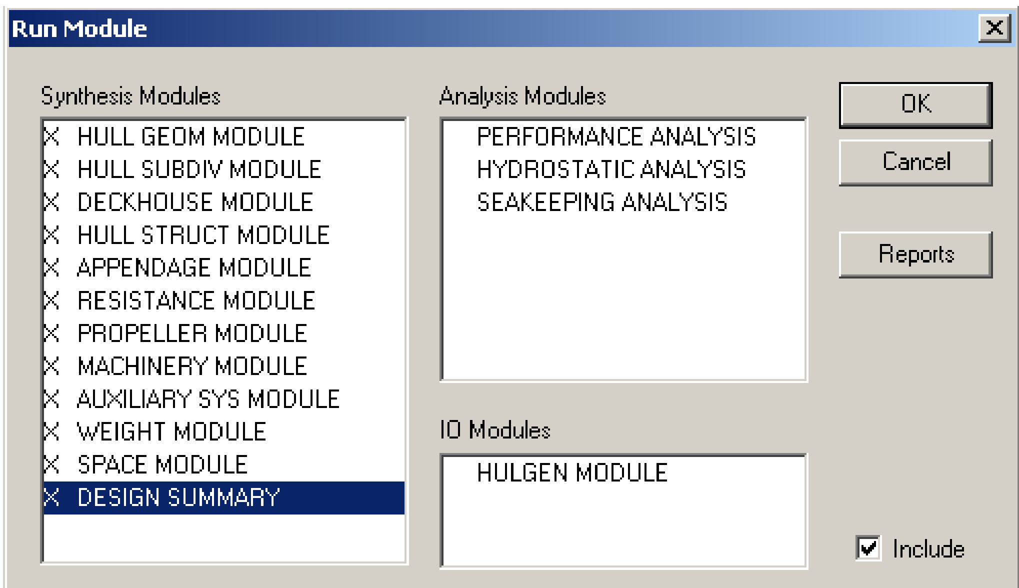
The Messages and Printed Reports window will have the following message:

```
CONVERGENCE ACHIEVED IN 12 ITERATIONS FOR THE FOLLOWING SYNTHESIS LOOP:
   BEGINNING MODULE = HULL GEOM MODULE
   ENDING MODULE    = DESIGN SUMMARY
SYNTHESIS PROCESS SUCCESSFULLY COMPLETED.
C,M>
```

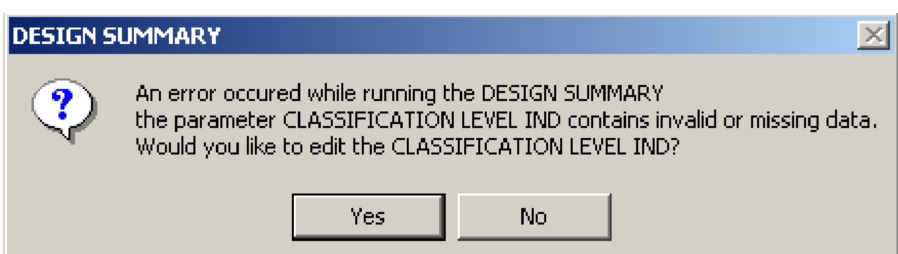
The synthesis process is complete. Your model has been converged to the set tolerance. At this point you should go back and review your model. It is also a good time to modify your ship in the attached data bank (**Ship⇒Modify**).

To generate data on your new model, set the desired printed and graphic reports to be generated by ASSET. For each report selected, run the corresponding module to produce the report.

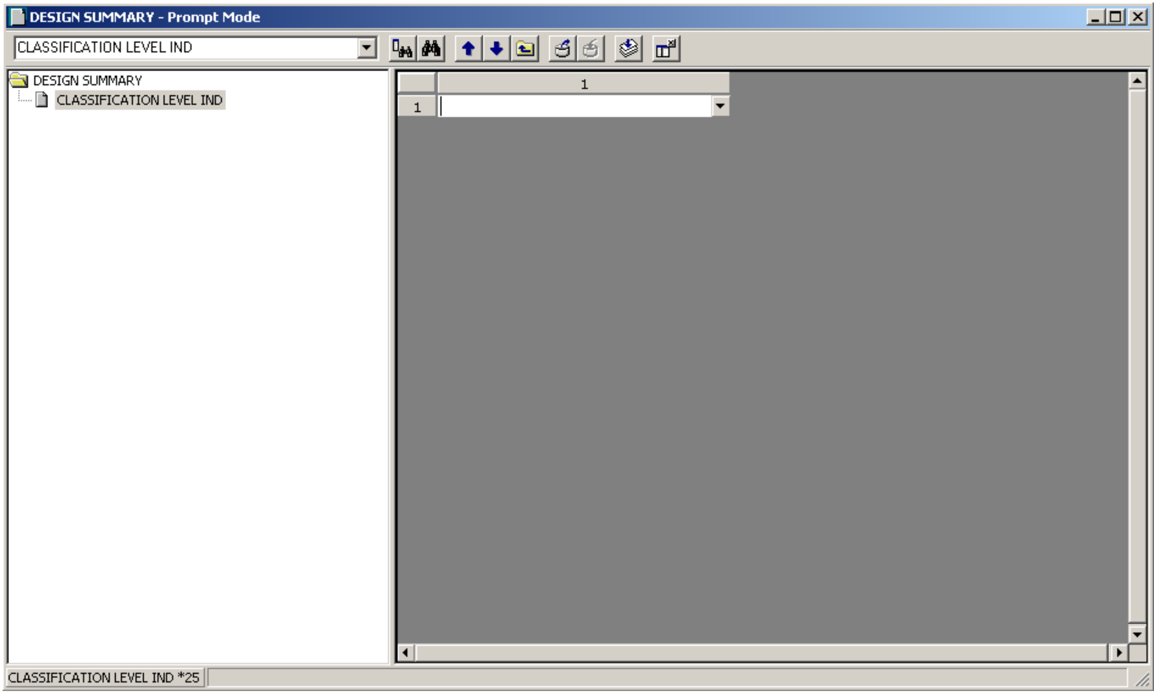
A good summary of your model is generated by the Design Summary Module Printed Report No. 1. After selecting **Run** from the Module menu, the following dialog box appears:



After selecting the Design Summary Module, click “OK” and ASSET returns with the following dialog box:



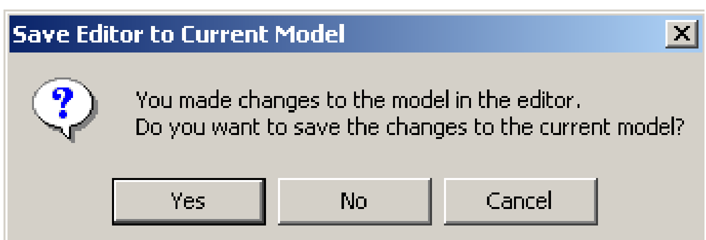
After clicking “Yes”, the Design Summary Module Editor Prompt window appears:



Read the on-line help for information concerning the parameters. Enter the requested information as follows:

CLASSIFICATION LEVEL IND: **UNCLASSIFIED**

After entering the data, the Save Editor to Current Model dialog box appears:



After clicking "Yes", the module runs again. A copy of the Design Summary Module summary report follows.

```
        ASSET/MONOSC V4.6.0 - DESIGN SUMMARY - 10/17/2000 17: 6.25
         DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO. 1 - SUMMARY

 SHIP COMMENT TABLE
      FRIGATE - TWIN SCREW - DIESEL - 2MMR - 2AMR - 2CIWS
      CREATED FOR ASSET MONOSC TUTORIAL
```

```
     TODD HEIDENREICH - 10/16/2000

  PRINCIPAL CHARACTERISTICS - M           WEIGHT SUMMARY - MTON
LBP                            131.0    GROUP 1 - HULL STRUCTURE   2022.4
HULL LOA                       137.6    GROUP 2 - PROP PLANT        707.3
BEAM, DWL                       17.2    GROUP 3 - ELECT PLANT       394.3
BEAM, WEATHER DECK              19.0    GROUP 4 - COMM + SURVEIL    181.1
DEPTH @ STA 10                  10.4    GROUP 5 - AUX SYSTEMS       719.5
DRAFT TO KEEL DWL                5.4    GROUP 6 - OUTFIT + FURN     441.3
DRAFT TO KEEL LWL                5.4    GROUP 7 - ARMAMENT          126.5
FREEBOARD @ STA 3                7.5    ---------------------------------
GMT                              2.3    SUM GROUPS 1-7             4592.4
CP                             0.578    DESIGN MARGIN               574.1
CX                             0.802    ---------------------------------
                                        LIGHTSHIP WEIGHT           5166.5
SPEED(KT):  MAX= 25.3  SUST= 24.0       LOADS                       739.8
ENDURANCE:  4000.0 NM AT 18.0 KTS       ---------------------------------
                                        FULL LOAD DISPLACEMENT     5906.3
TRANSMISSION TYPE:              MECH    FULL LOAD KG:  M              6.9
MAIN ENG: 4 D DIESEL @  5816.5 KW
                                        MILITARY PAYLOAD WT- MTON   423.2
SHAFT POWER/SHAFT:     10658.9 KW       USABLE FUEL WT - MTON       450.2
PROPELLERS: 2 - CP  -  4.4 M  DIA

SEP GEN:  4 D DIESEL @  2000.0 KW
                                                  OFF  CPO   ENL    TOTAL
24-HR LOAD                    1835.2    MANNING    18   16   153      187
MAX MARG ELECT LOAD           4117.6    ACCOM      20   18   167      205

     AREA SUMMARY - M2                       VOLUME SUMMARY - M3
HULL AREA           -       2922.       HULL VOLUME           -     16674.
SUPERSTRUCTURE AREA   -     1939.       SUPERSTRUCTURE VOLUME -      5342.
---------------------------------       ---------------------------------
TOTAL AREA          -       4861.       TOTAL VOLUME          -     22016.
```

Another informative report is the Summary Report generated by the Hull Geometry Module. This report shows the Stability Beam (the beam required to satisfy the GMT/B REQ) and the AREA BEAM (the beam required to provide the required arrangeable area). An objective of any design should be to make the Stability Beam and the AREA BEAM is as close to equal as possible. A copy of the Hull Geometry summary report follows.

```
      ASSET/MONOSC V4.6.0 - HULL GEOM MODULE - 10/17/2000 17:10.47
        DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO.  1 - HULL GEOMETRY SUMMARY

 HULL OFFSETS IND-GENERATE              MIN BEAM, M                  9.14
 HULL DIM IND-B+D+T                     MAX BEAM, M                 32.19
 MARGIN LINE IND-CALC                   HULL FLARE ANGLE, DEG       10.00
 HULL STA IND-OPTIMUM                   FORWARD BULWARK, M           1.22
 HULL BC IND-DDG 51
 FAST SHIP PARENT IND-

                    HULL PRINCIPAL DIMENSIONS (ON DWL)
                    ==================================
 LBP, M                         131.00    PRISMATIC COEF             0.578
```

```
HULL LOA, M                  137.60     MAX SECTION COEF            0.802
BEAM, M                       17.25     WATERPLANE COEF             0.771
BEAM @ WEATHER DECK, M        19.01     LCB/LBP                     0.506
DRAFT, M                       5.42     HALF SIDING WIDTH, M         0.30

DEPTH STA 0, M                13.37     BOT RAKE, M                  0.00
DEPTH STA 3, M                11.72     RAISED DECK HT, M            0.00
DEPTH STA 10, M               10.42     RAISED DECK FWD LIM, STA
DEPTH STA 20, M               11.54     RAISED DECK AFT LIM, STA
FREEBOARD @ STA 3, M           7.52     BARE HULL DISPL, MTON     5823.40

STABILITY BEAM, M             16.39     AREA BEAM, M                17.25

      BARE HULL DATA ON LWL                   STABILITY DATA ON LWL
      =====================                   =====================
LGTH ON WL, M                131.00     KB, M                        3.37
BEAM, M                       17.25     BMT,  M                      5.81
DRAFT, M                       5.42     KG,  M                       6.89
FREEBOARD @ STA 3, M           7.52     FREE SURF COR, M             0.00
PRISMATIC COEF                0.578     SERV LIFE KG ALW, M          0.00
MAX SECTION COEF              0.802
WATERPLANE COEF               0.772     GMT, M                       2.29
WATERPLANE AREA, M2         1745.02     GML, M                     304.62
WETTED SURFACE, M2          2283.49     GMT/B AVAIL                 0.133
                                        GMT/B REQ                   0.100
BARE HULL DISPL, MTON       5826.73
APPENDAGE DISPL, MTON         79.59
FULL LOAD WT, MTON          5906.31
```

Run the other synthesis modules to note any warning messages and to check that your design configuration is as you intended.

The next step in the design process is to identify areas in the design that need refinement. The next section in the tutorial addresses some typical design refinements.

6.18 DESIGN REFINEMENT

6.18.1 <u>Hull Geometry</u>

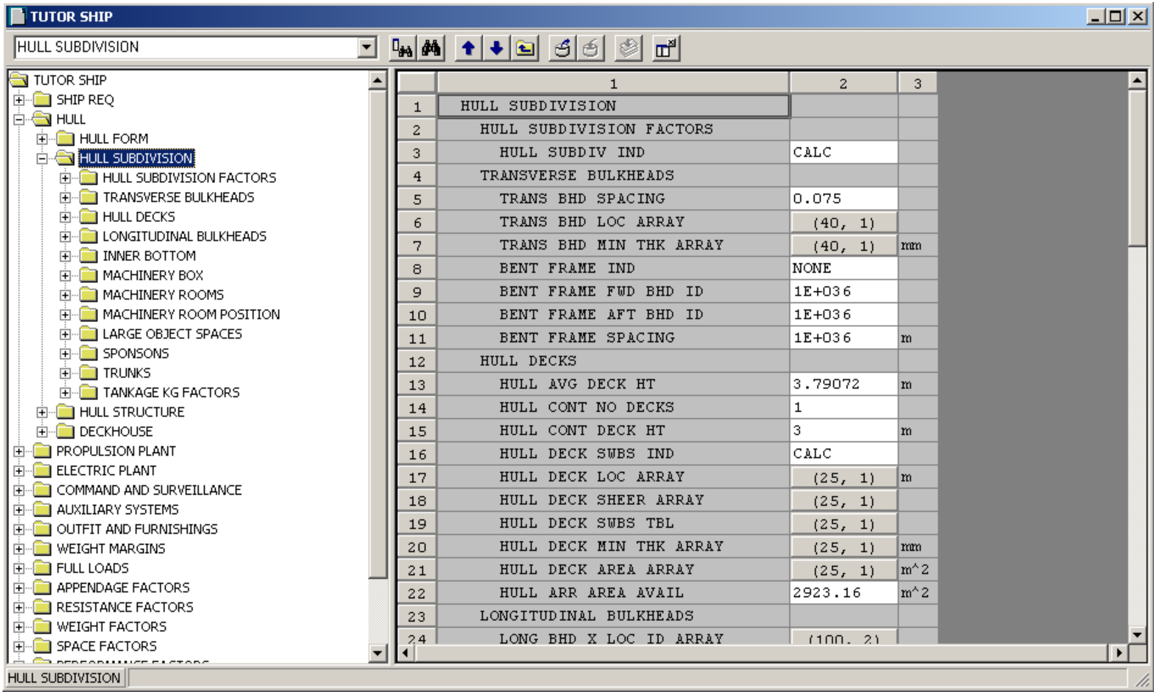
The first design refinement will be to modify the hull form to reflect the ship's increase in weight. Recall the equations used to estimate the prismatic and maximum section coefficients. They were based on full load displacement and maximum speed. The value used for displacement was an estimate (which turned out to be low). The first step is to recalculate the coefficients using the new displacement and maximum speed. Then, reset the corresponding parameters to these new values. This refinement should define the hull more accurately.

The results of the Design Summary show the full load displacement and max. speed of the current model are 5906.3 metric tons and 25.3 knots respectfully. From our example, the C_X = 0.802 and the C_P = 0.578. Enter the new full load displacement and max. speed values into the equations located in Section 6.6. You should get C_X = 0.8060 and C_P = 0.5796. Take these values and reset the corresponding parameters (MAX SECTION COEF and PRISMATIC COEF) in the current model. Run the Hull Geometry Module again to incorporate the changes.

6.18.2 Hull Subdivision

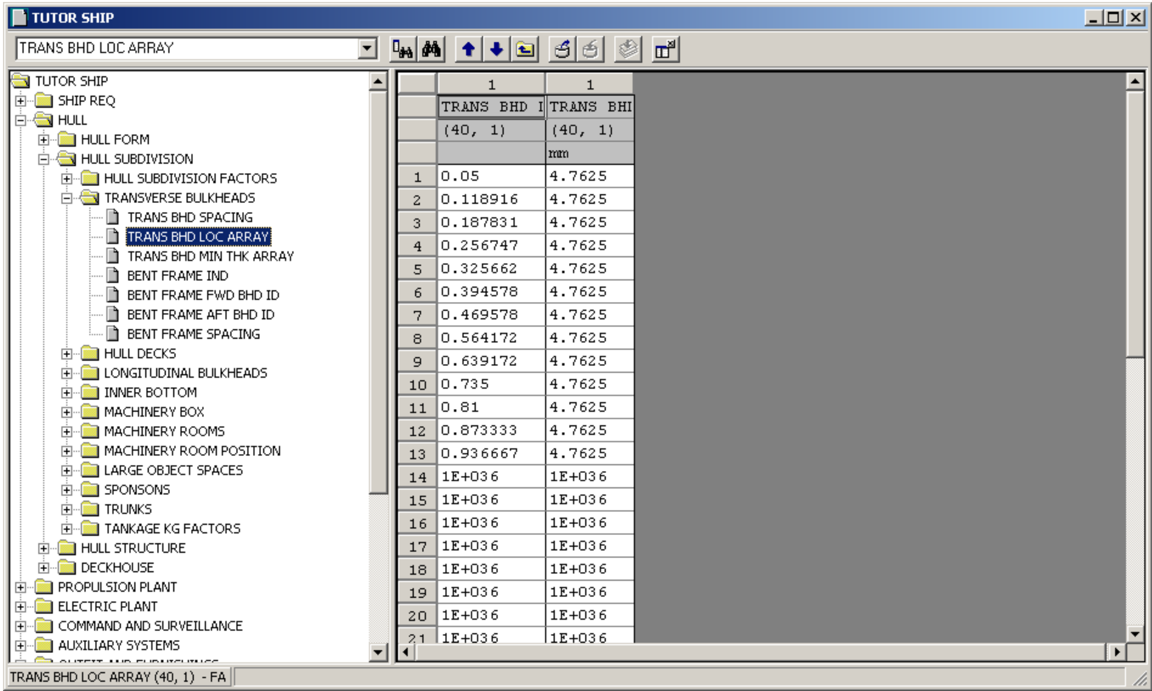
In our initial configuration, we set the HULL SUBDIV IND to **CALC** and we set the MR AFT BHD LOC to **0.81**. After the initial run through Synthesis, the Hull Subdivision Module has set the location of the transverse bulkheads and deck to ensure the machinery rooms are large enough to house the propulsion machinery and generator sets. However, the transverse bulkheads in the forward section of the hull are not in the location they need to be to accommodate the VLS and the other equipment we identified in the inboard profile.

To change the location of the forward transverse bulkheads, open the editor and locate the Hull Subdivision:



Set the HULL SUBDIV IND to **GIVEN**. This will fix the location of the bulkheads and decks. From the inboard profile, we can determine where the forward transverse bulkheads should be located. In ASSET, transverse bulkhead locations are measured from the forward perpendicular and input as a fraction of the LBP.

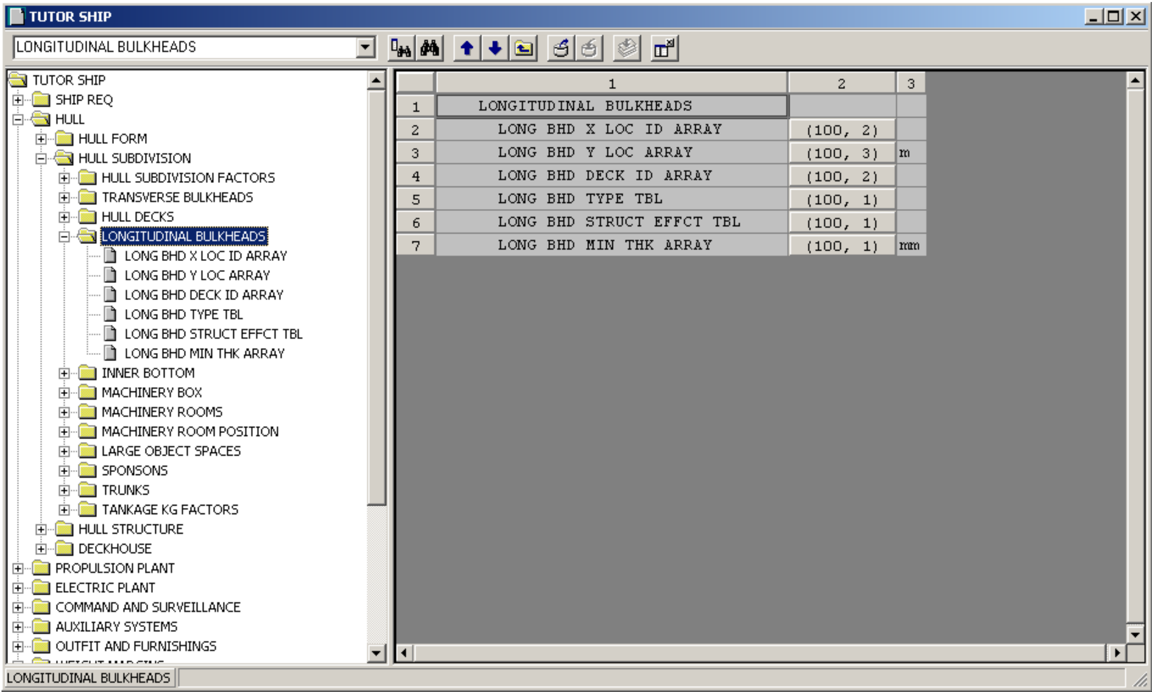
In the Editor, select the TRANS BHD LOC ARRAY. The following window should appear:



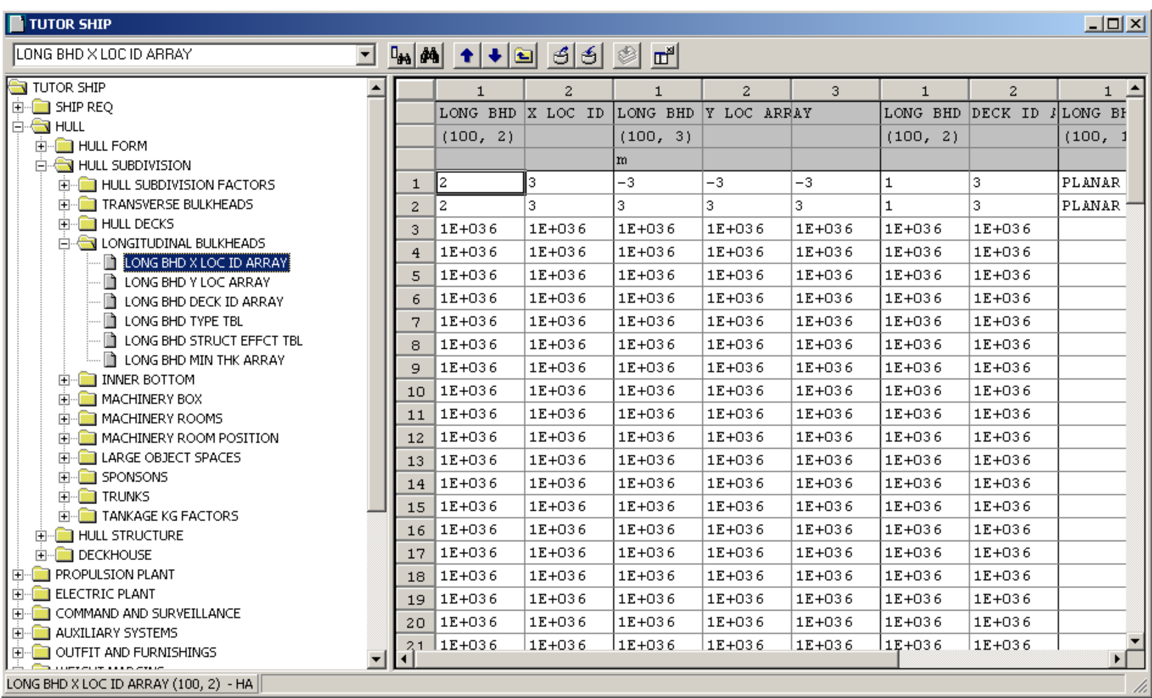
Change the first four rows of this array to **0.057**, **0.15**, **0.194**, and **0.25**.

Another thing you can do is to place two longitudinal bulkheads and a large object space to define the compartment for the Vertical Launching System (VLS). Based on the inboard profile, you want the VLS compartment to be located between transverse bulkheads #2 and #3, and decks 1 and 3. The first thing you need to do is define the longitudinal bulkheads. To do this, go into the Editor and click the following folders to get the table below:

HULL
HULL SUBDIVISION
LONGITUDINAL BULKHEADS



Under the LONGITUDINAL BULKHEADS folder, you will see six parameters. Please select the **LONG BHD X LOC ID ARRAY**, and the following table will appear:



The method of defining the longitudinal bulkheads will be from forward to aft, port to starboard, and upper to lower. The first two columns are the longitudinal bulkhead x-location identification array (LONG BHD X LOC ID ARRAY). This array defines the longitudinal bulkheads from the forward most transverse bulkhead to the aft most transverse bulkhead. Since the design calls for the VLS compartment to be between transverse bulkheads #2 and #3, you will put in the first two rows in the first two columns the following:

LONG BHD X LOC ID ARRAY—Row 1: **2 3**
Row 2: **2 3**

It may seem a little strange that we put this data in two rows, but it will make sense as we continue. The next parameter is the longitudinal bulkhead y-location array (LONG BHD Y LOC ARRAY). This array consists of three columns, and it defines the distance from the centerline of the ship to a corner of the bulkhead. The first column describes the actual distance from the centerline to the forward lower corner in meters. Column 2 defines the forward upper corner and Column 3 defines the aft lower corner. The positive values given in this section will refer to the starboard side of the ship, and negative values will refer to the port side of the ship. The two longitudinal bulkheads are symmetrical with the centerline of the ship. The plan is to have the VLS compartment to be six meters square—that is, three meters starboard and three meters port. We will enter data for the port side bulkhead in Row 1. Therefore, input the following values for this parameter:

LONG BHD Y LOC ARRAY—Row 1: **-3 -3 -3**
Row 2: **3 3 3**

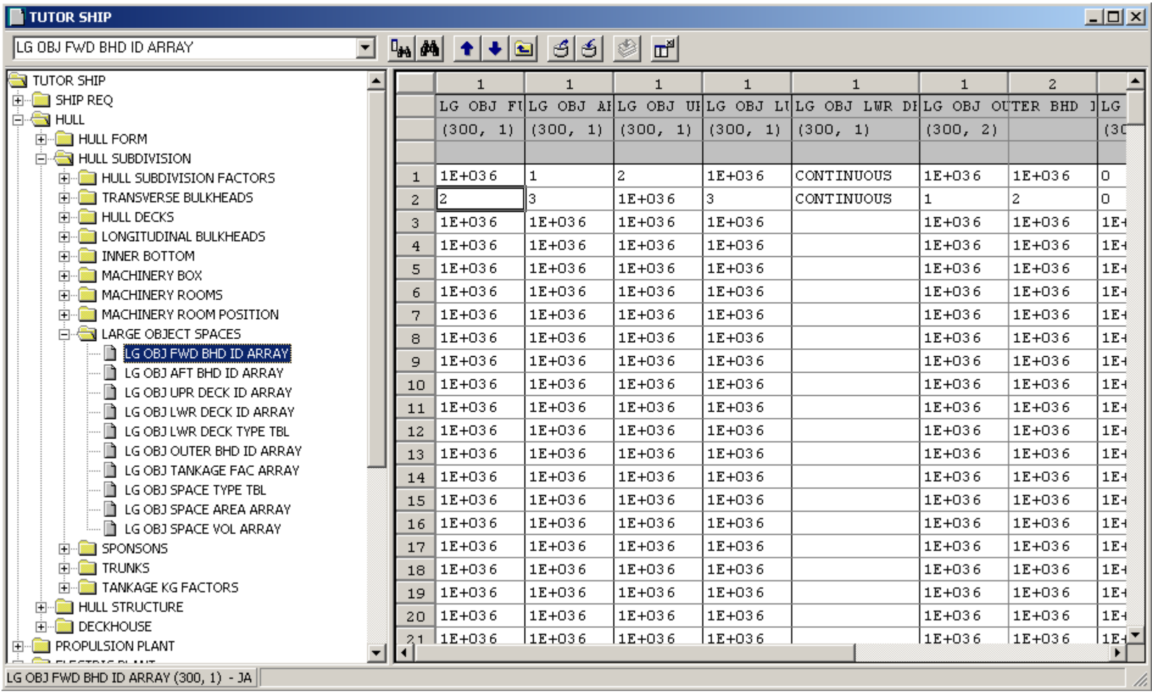
The next two columns are the longitudinal bulkhead deck identification array (LONG BHD DECK ID ARRAY). This parameter measures the upper and lower decks that a compartment will inhabit. As stated earlier, the VLS compartment will be between decks 1 and 3. Therefore, input the following values for this parameter:

LONG BHD DECK ID ARRAY—Row 1: **1 3**
Row 2: **1 3**

The next column is the longitudinal bulkhead type table (LONG BHD TYPE TBL). This parameter determines the type of longitudinal bulkhead. In this ship design, the longitudinal bulkheads will be parallel to the centerline plane. Therefore, the value that will go into both rows 1 and 2 is **PLANAR**.

The next parameter is the longitudinal bulkhead structural effectiveness table (LONG BHD STRUCT EFFECT TBL). This parameter is used to determine if the longitudinal bulkheads created will contribute to the longitudinal hull strength in the structural design within the Hull Structures Module. In the case of the longitudinal bulkheads that are a part of the design, you will choose **NO** because, these bulkheads will not contribute to the longitudinal structural strength of the ship.

Now that you have created the longitudinal bulkheads that will support the compartment, you can concentrate on developing the large object space. The large object space will remove the decks that are in the way of the VLS module. Click on the LARGE OBJECT SPACES folder and click the LG OBJ FWD BHD ID ARRAY. The following window will appear:



You will notice that a large object space already exists near the bow of the ship (row 1). You will use row 2 to create the large object space for the VLS compartment. You will define the large object space from forward and from port to starboard.

The first two columns are the large object forward/aft bulkhead identification array (LG OBJ FWD BHD ID ARRAY, LG OBJ AFT BHD ID ARRAY). These parameters identify the forward and aft boundaries of the large object space. As stated earlier, the VLS compartment will be created between transverse bulkheads #2 and #3. Therefore, input the following values for these parameters:

LG OBJ FWD BHD ID ARRAY: **2**
LG OBJ AFT BHD ID ARRAY: **3**

The next two parameters are the large object upper/lower deck identification array (LG OBJ UPR DECK ID ARRAY, LG OBJ LWR DECK ID ARRAY). These parameters identify the upper and lower boundaries of the large object space. As stated earlier, the VLS compartment will extend from deck 1 to deck 3. However, the VLS module will extend through deck 1. By leaving the upper deck id as the no-data value the Hull Subdivision will cut out the section of deck1 that is above the large object space. Therefore, input the following values for these parameters:

LG OBJ UPR DECK ID ARRAY: **1E+36**
LG OBJ LWR DECK ID ARRAY: **3**

The next parameter is the large object lower deck type table (LG OBJ LWR DECK TYPE TBL). This parameter determines whether the lower boundary continues to the adjacent compartments or it is just a part of the compartment alone. You will choose **CONTINUOUS** because you want the lower boundary to extend to the adjacent compartments.

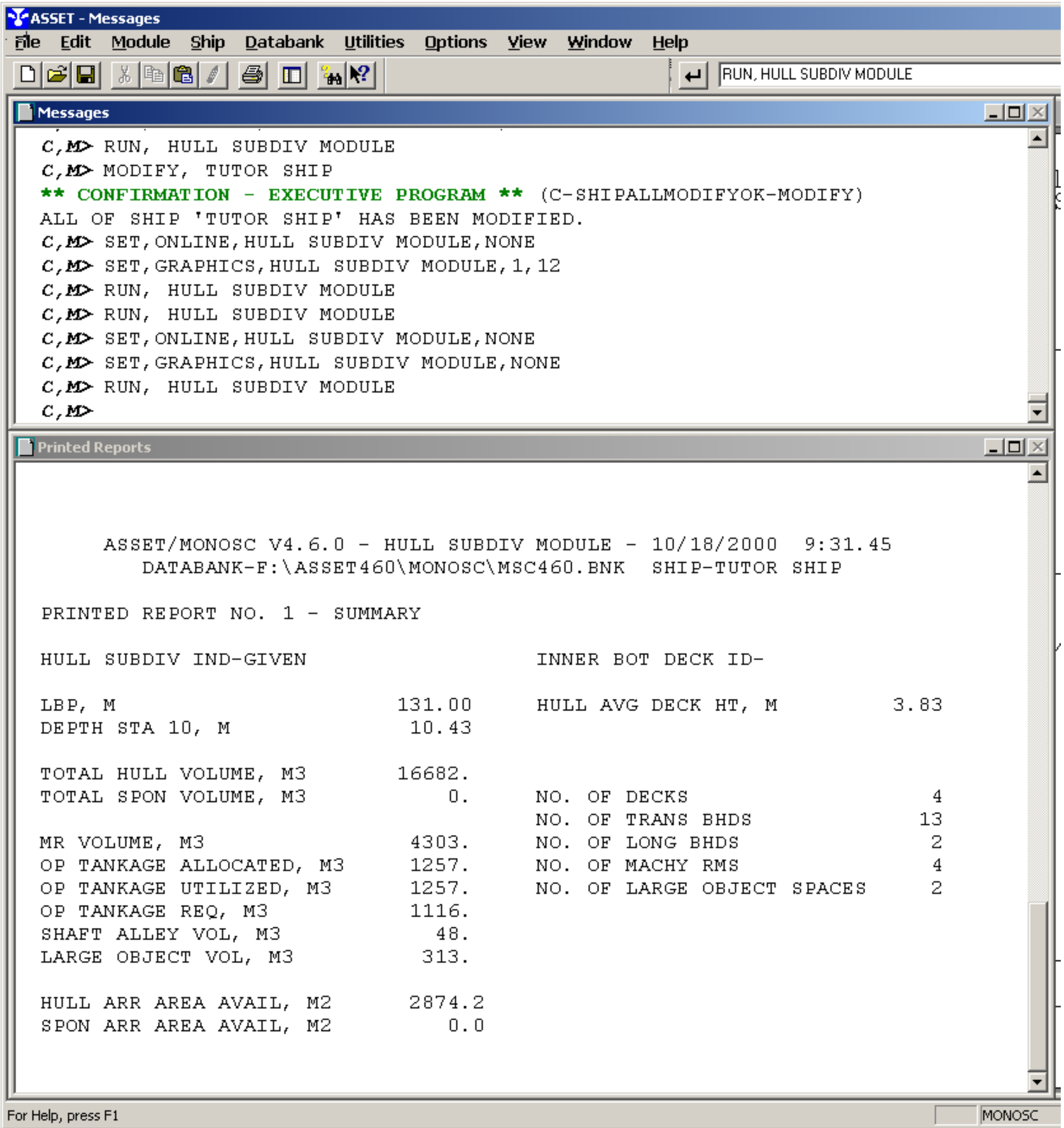
The next parameter is the large object outer bulkhead identification array (LG OBJ OUTER BHD ID ARRAY). This parameter identifies the outer longitudinal bulkhead boundaries—port and starboard—of the compartment. We defined the port bulkhead in Row 1 of the Longitudinal Bulkhead Group. Therefore, the input to this parameter shall be:

	Column 1	Column 2
LG OBJ OUTER BHD ID ARRAY	**1**	**2**

The next parameter is the large object tankage factor array (LG OBJ TANKAGE FAC ARRAY). This parameter determines the percentage of the compartment will be used for operational tankage or storage. What could be stored is fuel, ballast, etc. Since this is a VLS compartment, none of the compartment will be used as operational tankage. ASSET will default this parameter to **0**.

The last two columns—the large object space area/volume array (LG OBJ SPACE AREA ARRAY, LG OBJ SPACE VOL ARRAY)—defines the area and volume respectfully of the compartment. The Hull Subdivision Module will calculate this information and fill in this array.

After you have inputted the last values, get out of the Editor and save your inputs. Rerun the Hull Subdivision Module again. This time, select all the printed and graphic reports. The Messages and Printed Reports windows will look like this:

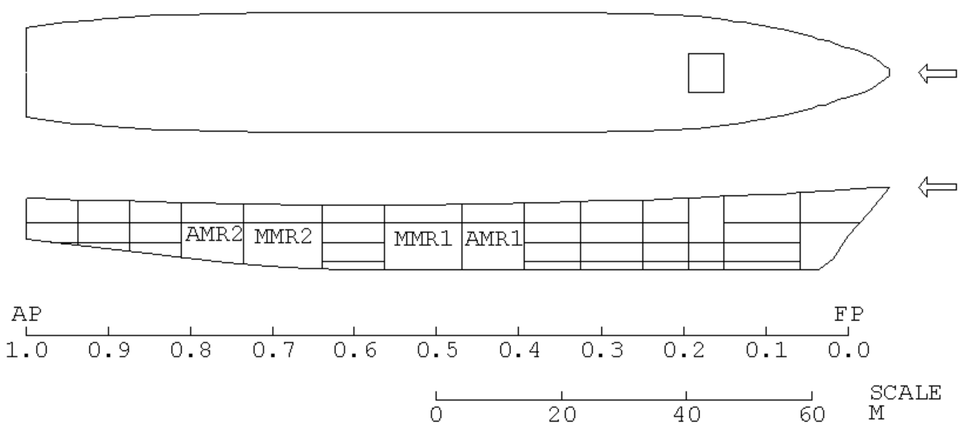


If you want to see how the VLS compartment looks, run the Graphic Displays #1 and 12. The following illustrations show what they look like.

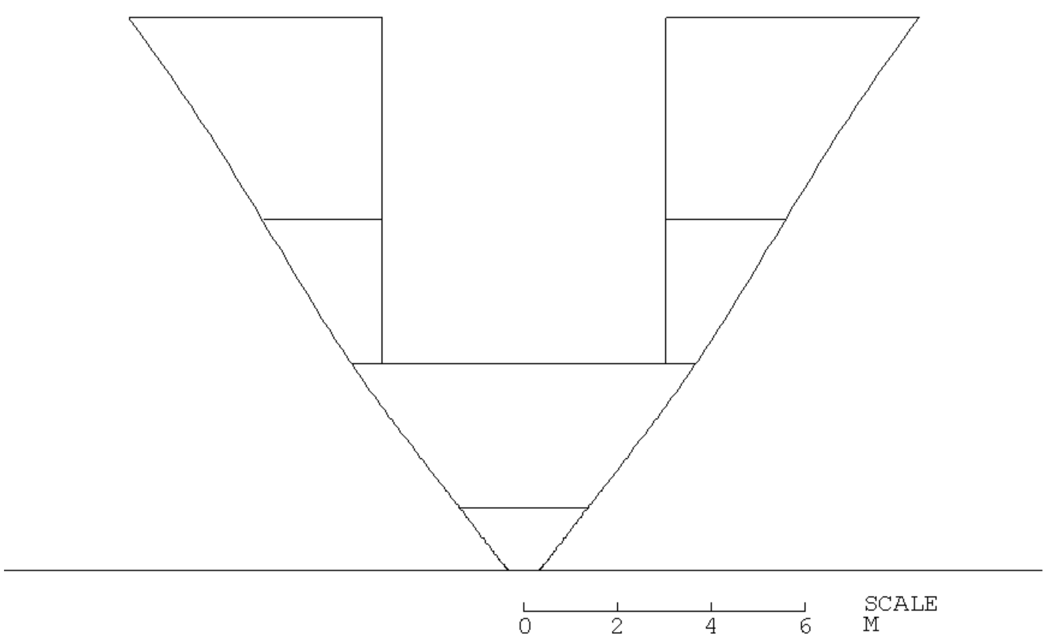
ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/18/2000 9:28.31
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - HULL DECKS AND PLATFORMS

MAIN DECK
(DECK NO. 1)

DECK AREA, M2	2295.3
TOTAL SHIP ARR AREA, M2	2874.2
TOTAL HULL VOLUME, M3	16682.

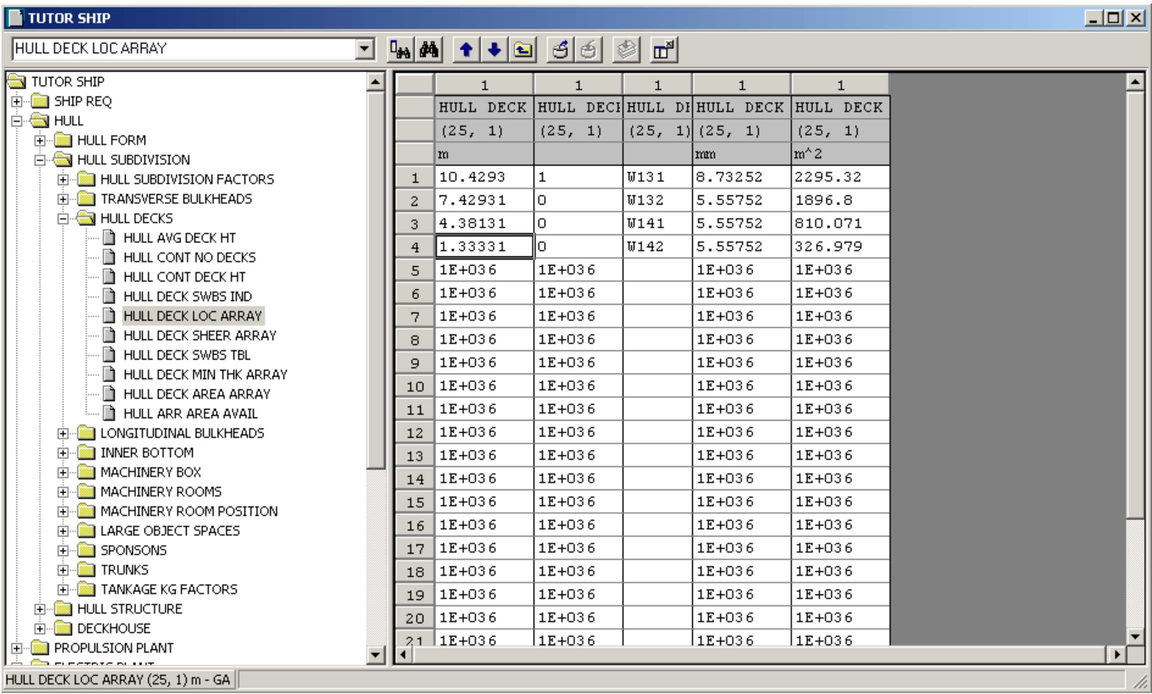


ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/18/2000 9:28.31
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO.12 - SECTION AT 19.7 - TBKHD # 2



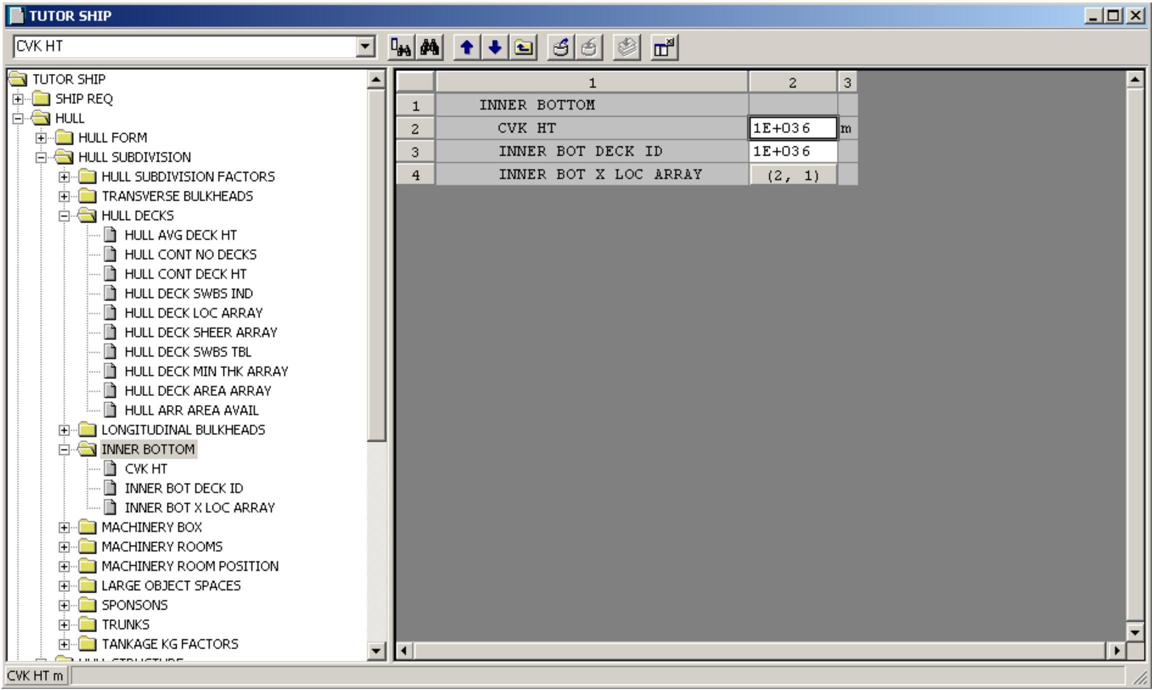
Take the time to review all the information provided in these reports. Save your module by clicking **Ship⇒Modify**.

We also want to designate the lowest deck as an inner bottom. In the Editor, locate the HULL DECK LOC ARRAY.



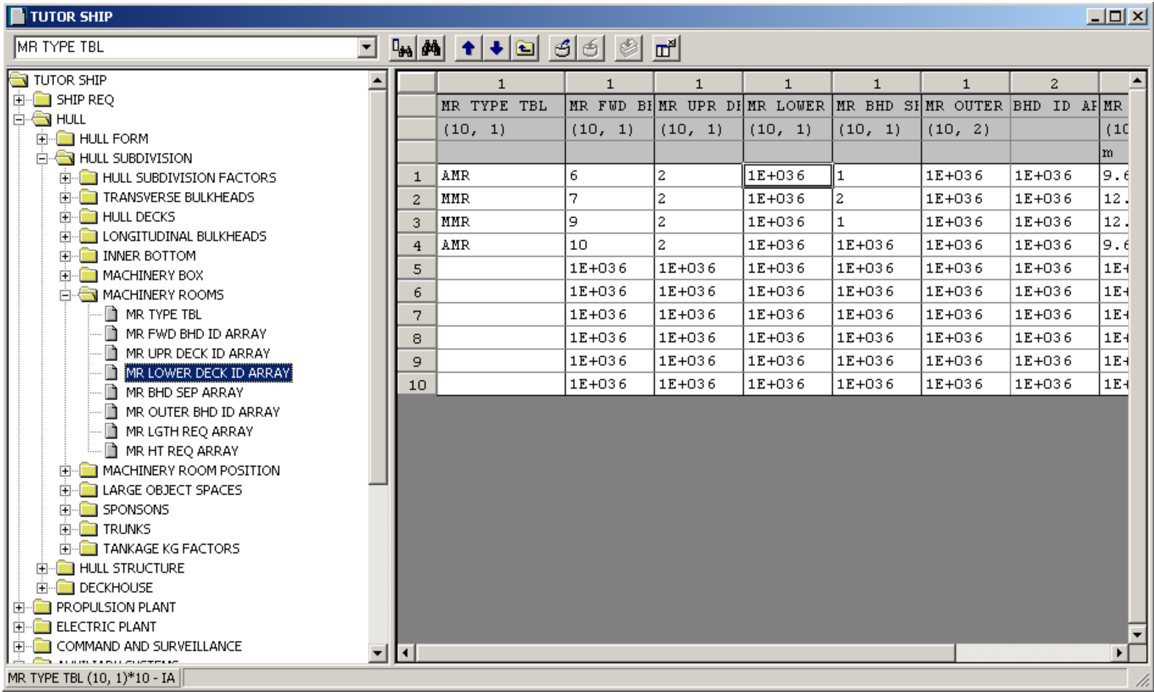
Note how many decks have been defined (4) and the value in the HULL DECK LOC ARRAY for this deck (**1.33331 m**).

Now in the Editor, find the INNER BOTTOM group. The following window should appear:



Set the CVK HT equal to the value in the HULL DECK LOC ARRAY (**1.33331 m**). Set the INNER BOT DECK ID equal to **4** (the row number of the lowest deck in the HULL DECK LOC ARRAY).

Once again, in the editor, find the MACHINERY ROOMS group. After selecting the MR LOWER DECK ID ARRAY the editor window should look like:



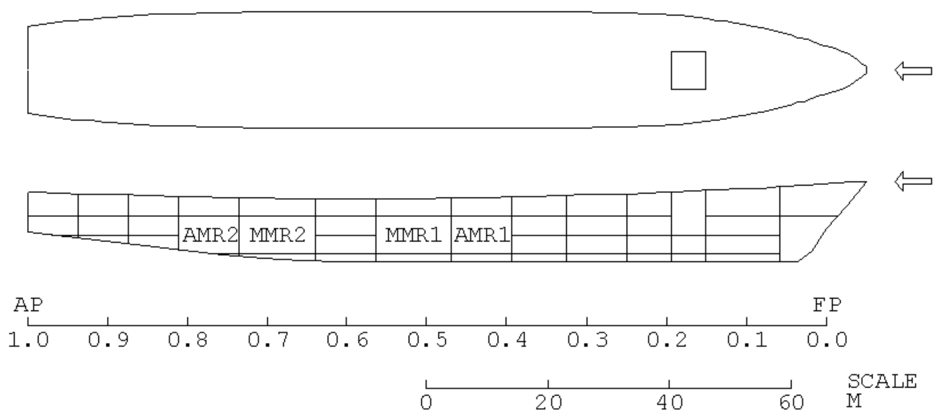
The original definition for the machinery rooms had the no-data value for the lower deck ID for each of the machinery spaces, which specified that the machinery spaces were to extend completely down to the bottom shell plating. Now that we wish to have an inner bottom, we need to change the lower deck ID for the machinery spaces. Set the MR LOWER DECK ID equal to **4** (the row number of the lowest deck in the HULL DECK LOC ARRAY) for each of the machinery spaces.

Close the Editor and save the changes to the current model. Pull down the **Run Module** dialog and select the HULL SUBDIV MODULE. Click the **Reports** button and select some of the graphic reports (at least Graphic Report #1). Click the **Run** button to run the Hull Subdivision Module. Note in Graphic Report #1 that the forward transverse bulkhead locations have been changed to match our original inboard profile and the large object space for the VLS is now square in the plan view.

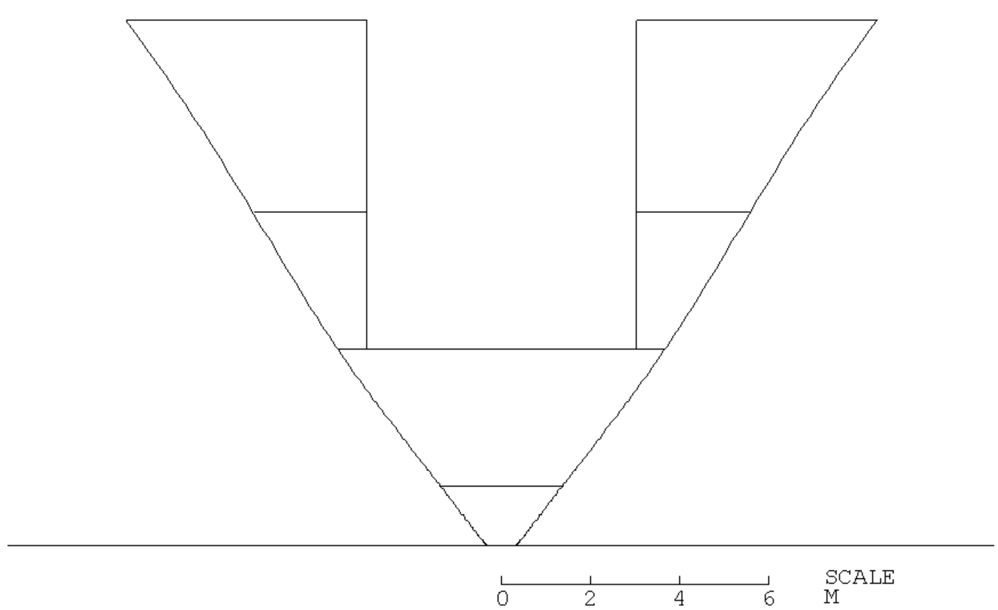
ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/18/2000 10:58.25
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - HULL DECKS AND PLATFORMS

MAIN DECK
(DECK NO. 1)

DECK AREA, M2	2295.3
TOTAL SHIP ARR AREA, M2	2978.8
TOTAL HULL VOLUME, M3	16682.



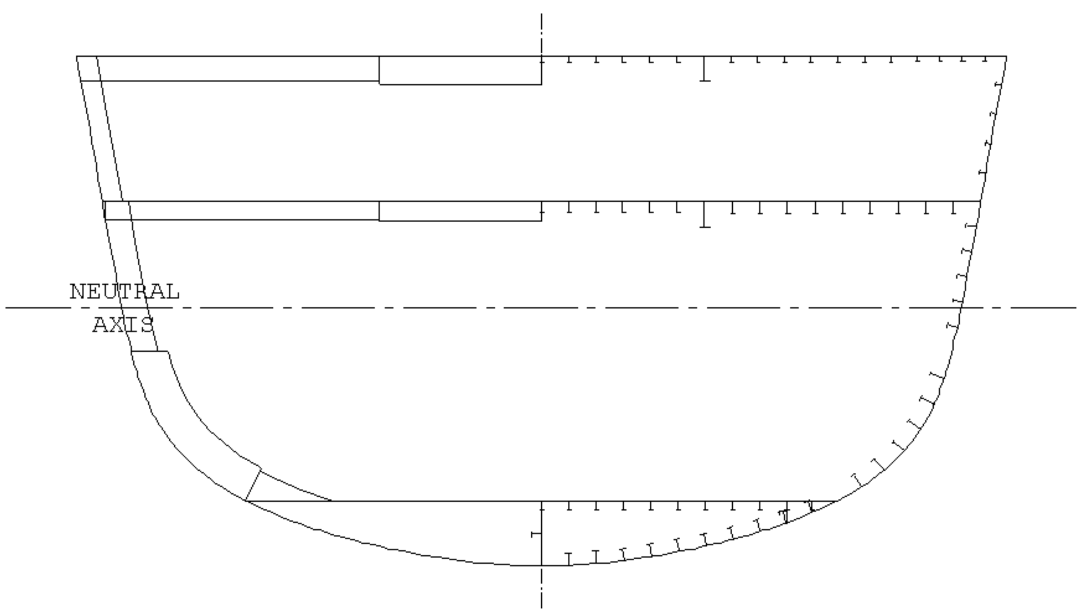
ASSET/MONOSC V4.6.0 - HULL SUBDIV MODULE - 10/18/2000 10:58.25
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO.12 - SECTION AT 19.7 - TBKHD # 2



6.18.3 Hull Structure

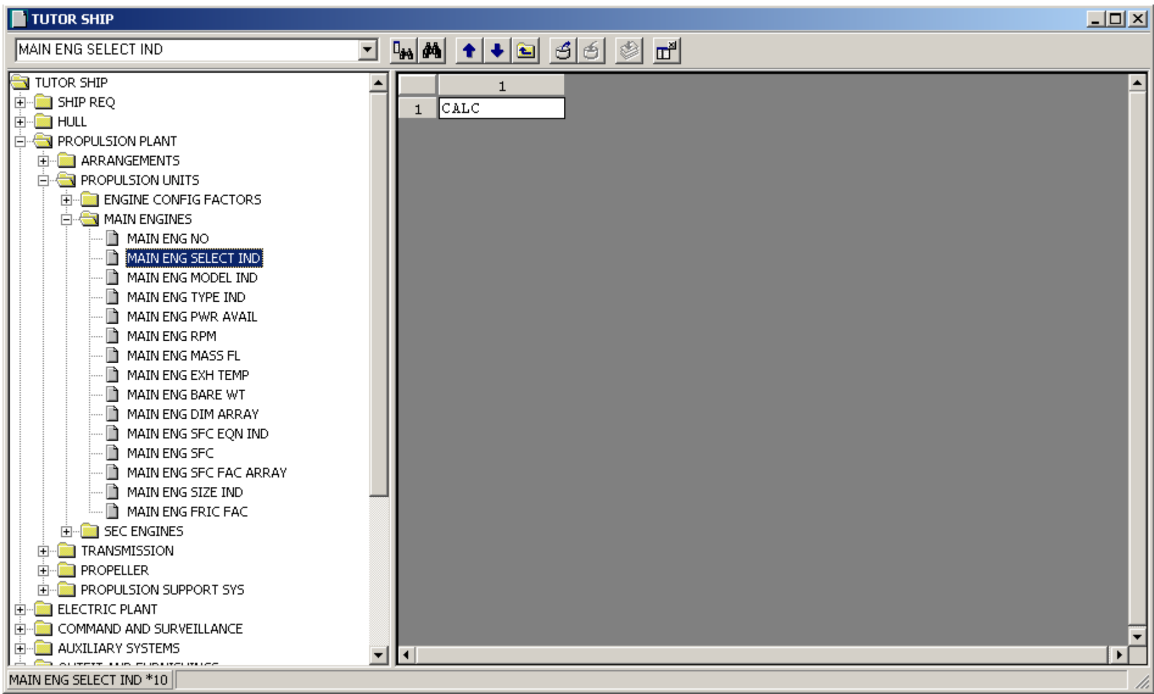
In the Hull Subdivision Module, changes we specified that the lowest deck should be designated as an inner bottom. Run the Hull Structures Module to show how this changed the design in the inner bottom area.

ASSET/MONOSC V4.6.0 - HULL STRUCT MODULE - 10/18/2000 11: 1.14
DATABANK-F:\ASSET460\MONOSC\MSC460.BNK SHIP-TUTOR SHIP
GRAPHIC DISPLAY NO. 1 - SECTION AT THE STRUCTURAL DESIGN LOCATION

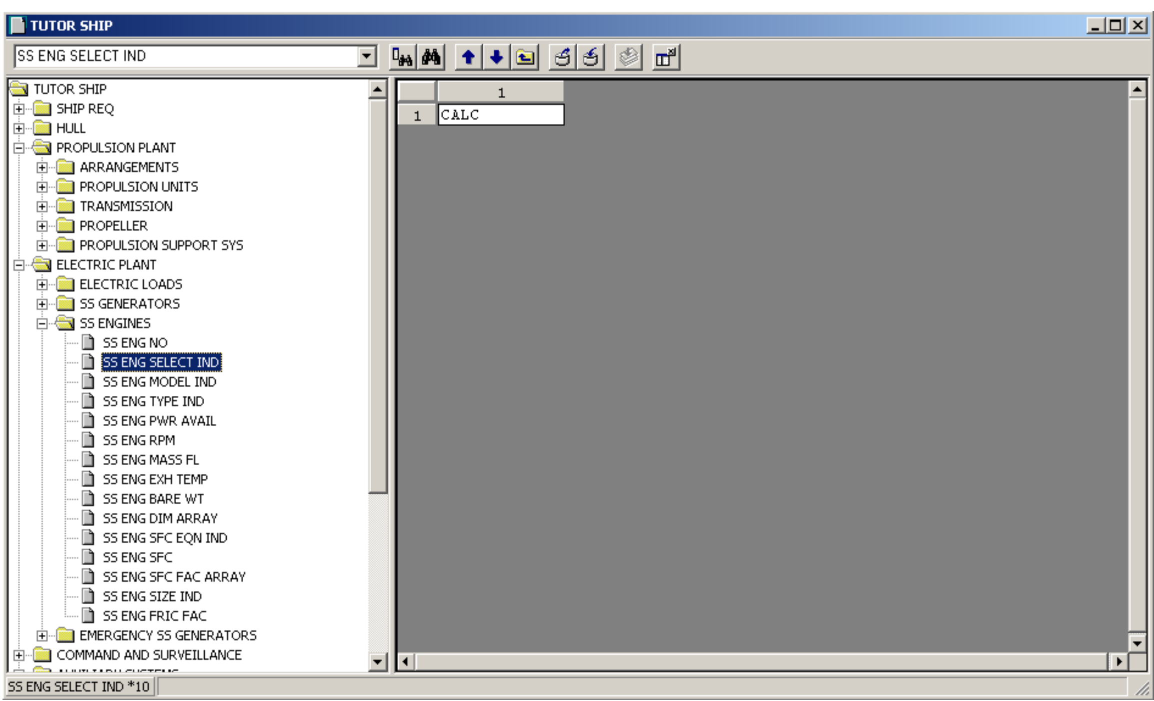


6.18.4 Machinery

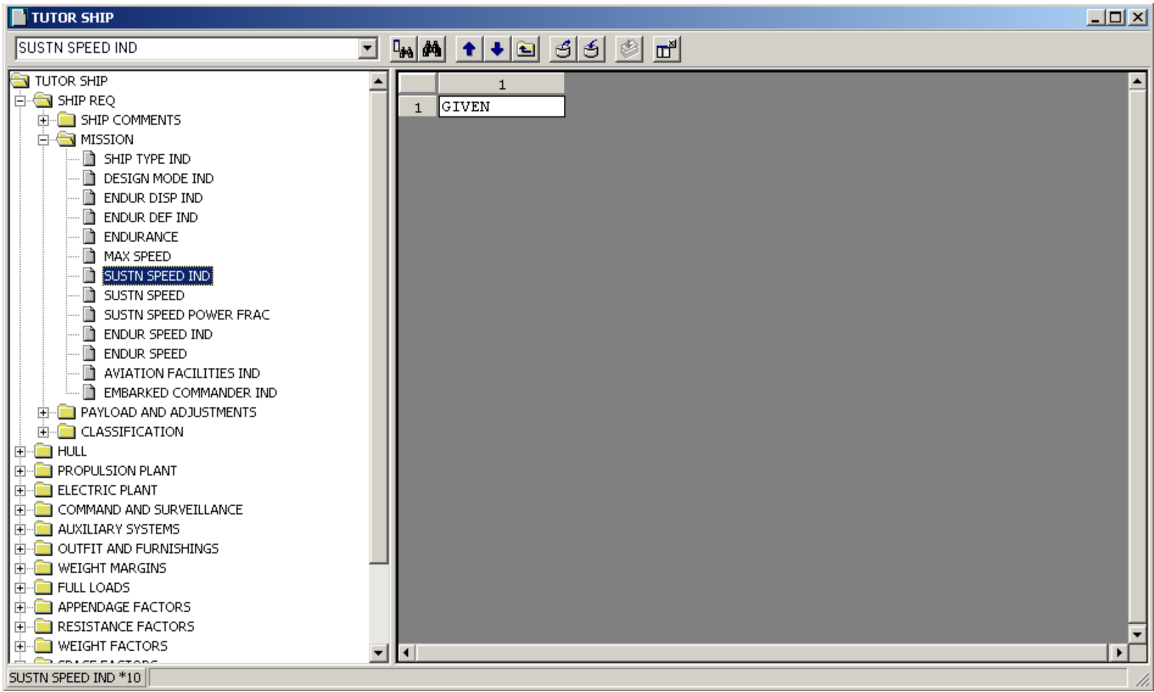
In the initial run through Synthesis, specific engine models were selected for the MAIN ENGINES and SS ENGINES. At this time, we want to specify that those engine models are to be fixed and not changed of the powering requirements change. To do this, open the Editor and find the MAIN ENG SELECT IND.



Change this parameter from **CALC** to **GIVEN**. Also, find the SS ENG SELECT IND:



Change it to **GIVEN**. Finally, find the SUSTN SPEED IND:



Change it to **CALC**. Close the Editor and save the changes to the current model. With these changes, ASSET will maintain the engine models and calculate the sustained speed that can be achieved with these engines. Run the Machinery Module and note the sustained speed reported in Printed Report #1.

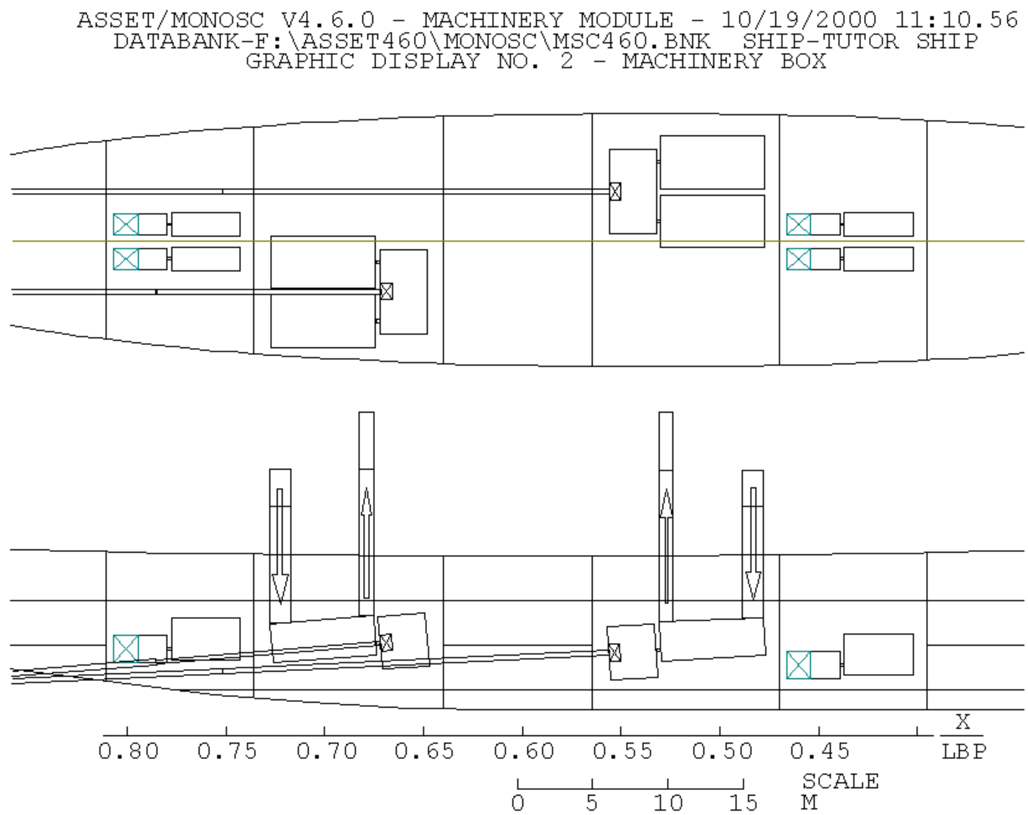
```
       ASSET/MONOSC V4.6.0 - MACHINERY MODULE - 10/18/2000 11:16.26
         DATABANK-F:\ASSET460\MONOSC\MSC460.BNK  SHIP-TUTOR SHIP

 PRINTED REPORT NO. 1 - SUMMARY

 TRANS TYPE IND              MECH     MAX SPEED, KT               25.39
 ELECT PRPLN TYPE IND                 SUSTN SPEED IND              CALC
 SHAFT SUPPORT TYPE IND OPEN STRUT    SUSTN SPEED, KT             24.19
 NO PROP SHAFTS                2.     SUSTN SPEED POWER FRAC      0.800
 SEC ENG USAGE IND                    ENDUR SPEED IND             GIVEN
 SS SYS TYPE IND              SEP     ENDUR SPEED, KT             18.00
 PD SS TYPE IND                       DESIGN MODE IND         ENDURANCE
 MAX MARG ELECT LOAD, KW     4232.    ENDURANCE, NM               4000.
 AVG 24-HR ELECT LOAD, KW    1883.    USABLE FUEL WT, MTON        463.4
 SWBS 200 GROUP WT, MTON     723.5    SWBS 300 GROUP WT, MTON     394.9
 NO BOILERS PER SHAFT          0.     NO RESERVE BOILERS             0.
 AUX STEAM FAC               0.000

                                           NO      NO ONLINE  NO ONLINE
```

ARRANGEMENT OR SS SYSTEM	TYPE	INSTALLED	MAX+SUSTN	ENDURANCE
MECH CL/PORT ARR IND	M2-HOSR	1	1	1
MECH STBD ARR IND	M2-HOSR/F	1	1	1
SEP SHIP-SERVICE SYSTEM	2000. KW	4	3	3
PD SHIP-SERVICE SYSTEM	KW	0	0	0

	MAIN ENG	SEC ENG	SS ENG
ENG SELECT IND	GIVEN		GIVEN
ENG MODEL IND	PC 2.5V12		A 12V251F
ENG TYPE IND	D DIESEL		D DIESEL
ENG SIZE IND	GIVEN	GIVEN	GIVEN
NO INSTALLED	4	0	4
ENG PWR AVAIL, KW	5816.	.	2088.
ENG RPM	520.0		1200.0
ENG SFC, KG/KW-HR	0.207		.217
ENG LOAD FRAC	1.000		.997

If you desire, you could investigate the impact of using different engine models by opening the Machinery Module Wizard, going to the Main Propulsion Engine Specification page and selecting another engine. After exiting the wizard, run Synthesis. After Synthesis is converged, run Design Summary and check the Printed Report #1 to see if your ship can make the required sustained speed (24 knots) and what changes were generated by the change of engines. Note that we have fixed the location of all decks and bulkheads in the Hull Subdivision. If you selected a new engine that is larger than the original engines selected, you may have to relocate some transverse bulkheads and/or decks to make the machinery rooms large enough for the new engines. This change should be done before you run Synthesis.

Look at the machinery box graphic report generated by the Machinery Module (Graphic Report #2):

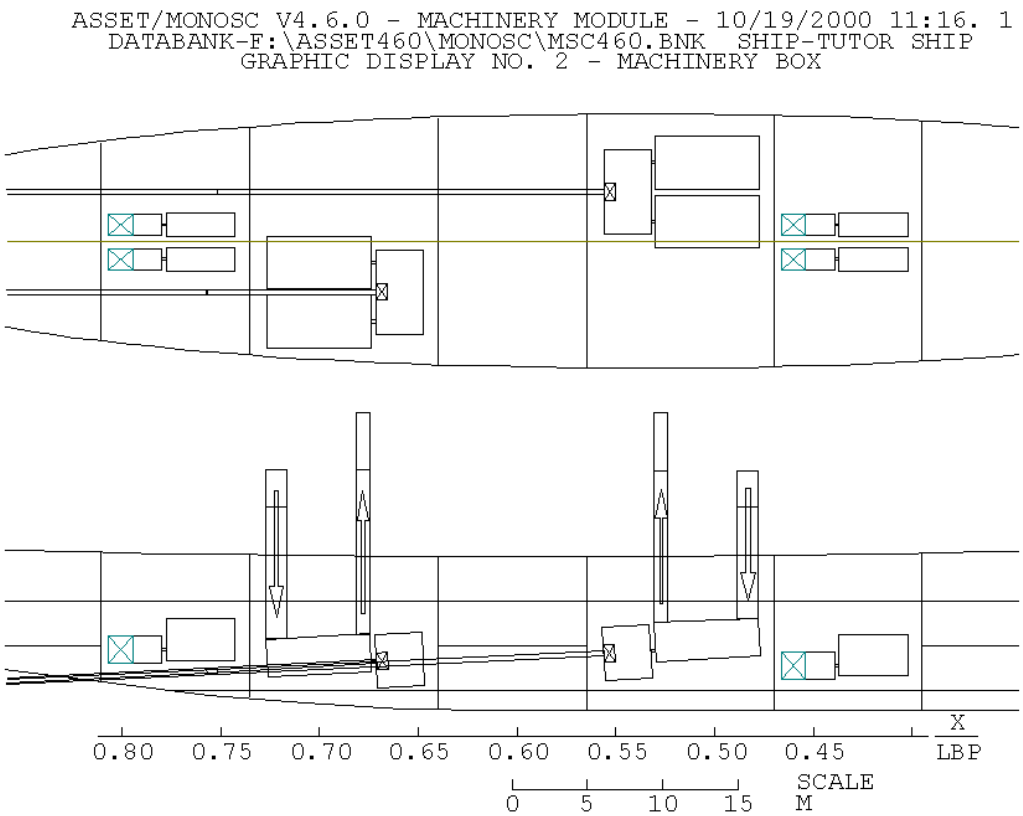


The aft propulsion arrangement is somewhat awkward. The starboard shaft seems to be at a large angle. If you recall the warning messages generated while running synthesis, you will remember that the shaft angle for the starboard shaft was hovering around the maximum of five degree. Check the SHAFT ANGLE ARRAY to see what angle was finally determined.

```
C,M> sh,shaft angle array
COMMAND STRING IS:
  SHOW,SHAFT ANGLE ARRAY
      SHAFT ANGLE ARRAY           = (  2X  2)     DEG
  1  2.720
  2  4.812
C,M>
```

The starboard shaft angle is near five degrees. A good design refinement is to reduce this angle. There exists room to move the starboard propulsion arrangement lower. First, go into the Editor and type "MACHY KG IND" in the parameter box. Click the **Jump To** button to get MACHY KG IND parameter. Change the value from **CALC** to **GIVEN**. Then set the KG (Sect 6.13 MAIN ENG KG ARRAY) of the aft propulsion arrangement (the bottom number) to **0.35**. Run the module again. The shaft angle has decreased considerably (from approx. 5° to 3°).

```
C,MD> sh,shaft angle array
COMMAND STRING IS:
  SHOW,SHAFT ANGLE ARRAY
      SHAFT ANGLE ARRAY          = (  2X  2)     DEG
  1  2.713
  2  3.013
C,MD> |
```

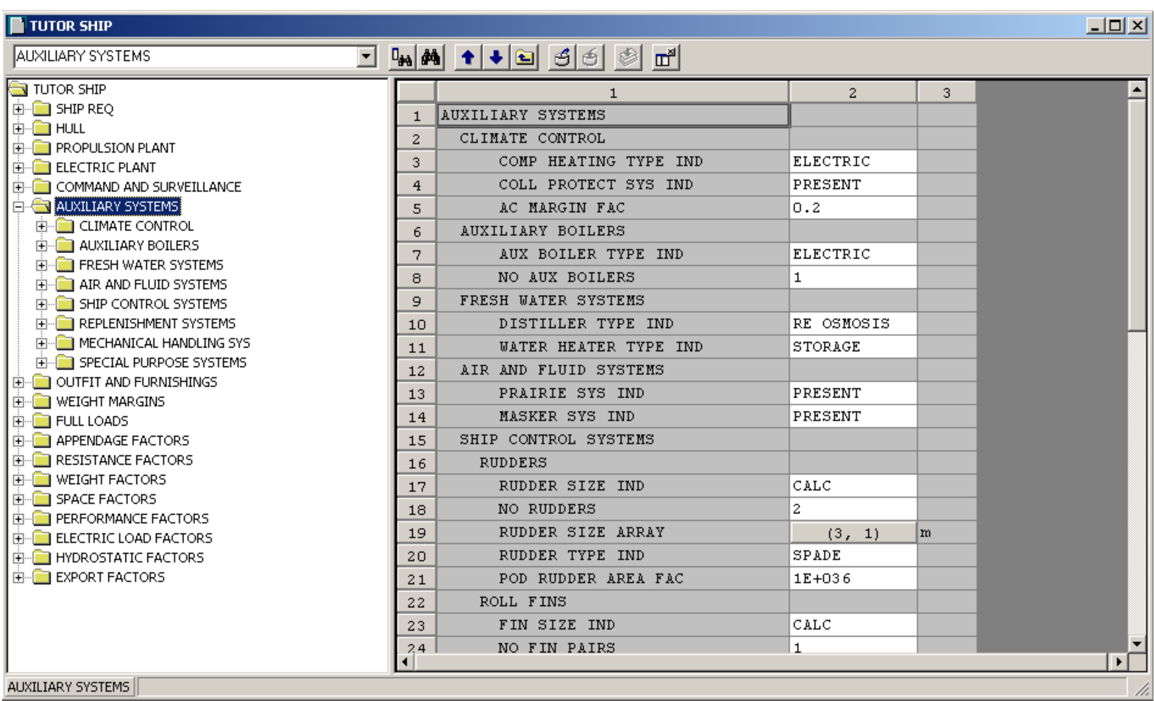


6.18.5 Auxiliary Systems

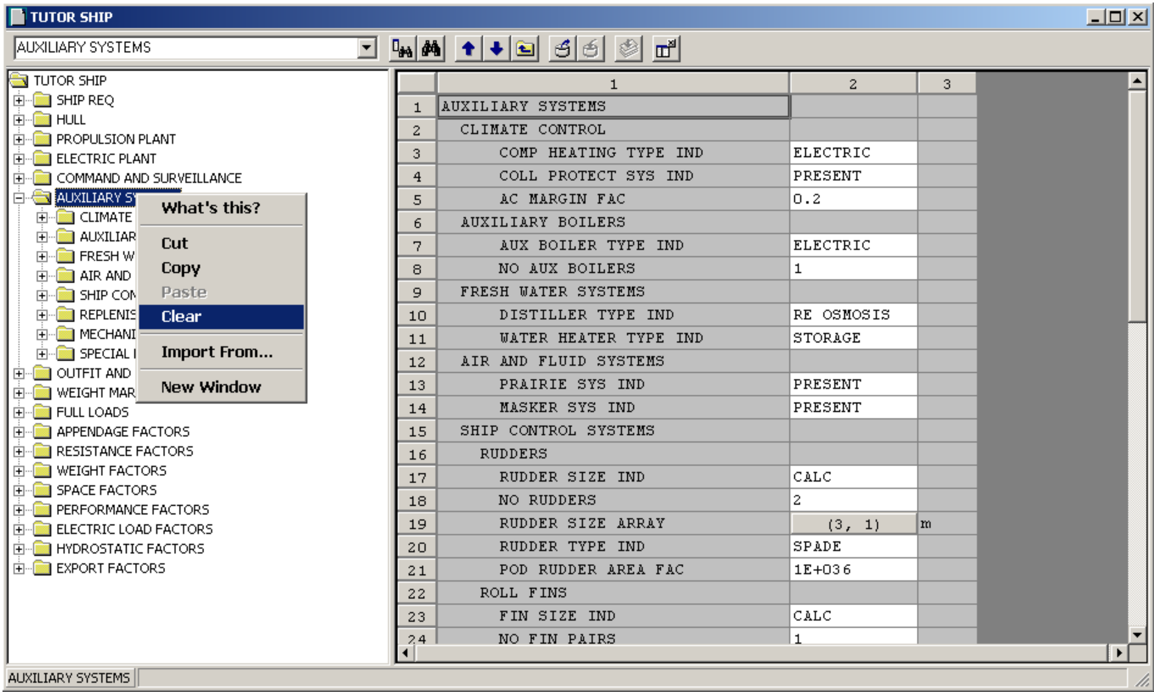
Recall that all parameters defaulted to an ASSET-generated value when you ran the Auxiliary Module for the first time. These default values are based on ship size and manning. In the course of your design, the ship has increased in beam, depth, and weight. With this in mind, it is best to assign new default values to the parameters associated with the auxiliary system. To do this, first you must reinitialize these parameters.

Refer to section 6.14 and note the parameters that were assigned default values. Since manning has not changed since this module was run originally, many of these parameters contain valid data. Others, which are based on ship size, need to be updated. To be sure - that all parameters that need updating are updated, reinitialize any parameter that might be linked to ship size. To be 100% certain, you can reinitialize all the parameters.

The easiest way to reinitialize the Auxiliary Systems parameters is to go into the Editor and select the Auxiliary Systems folder:



After selecting the Auxiliary Systems, click the right mouse button to get the menu:



Select **Clear** from the menu. This will clear all the parameters in that group. After clearing these parameters and running the Auxiliary Systems Module again, ASSET will generate new values based on the present ship design.

After reinitializing the parameters, reset the RUDDER TYPE IND to a **SPADE** rudder and run the Auxiliary Systems Module. At this point, ASSET fills the reinitialized parameters with new default values-- ones more suited to the latest model.

6.18.6 Synthesis

At this point, all of your input for design synthesis is complete. You now need to run Synthesis again. Running Synthesis will allow ASSET to incorporate the new enhancements into the entire design and rebalance the ship characteristics. Generally, it is a good practice to run Synthesis after each individual change. In this case, the various refinements do not have a significant direct impact of the other refinements so you can wait to run Synthesis. Modify your ship in the attached data bank (**Ship⇒Modify**).

6.19 DESIGN CHANGES

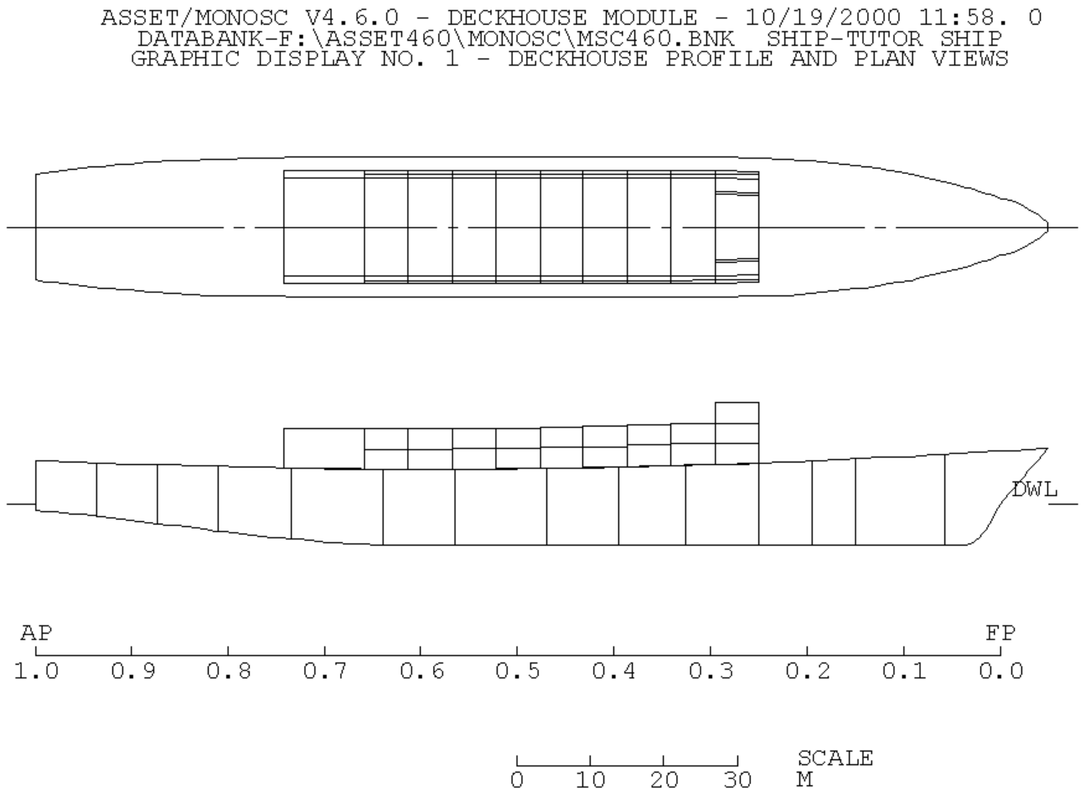
This section will guide you through two changes in your design. The first change will be to create two deckhouses instead of one. Splitting the deckhouse and moving the aft piece farther aft will do this. The second design change will be to change the propulsion transmission from mechanical to electric drive. The electric propulsion plant will be powered by gas turbines. These changes are independent, and should be done on the model created after the above design refinements. Once each change is made, the model should be refined again.

6.19.1 Two Deckhouses

This design modification could become a necessity if the length of the deckhouse increases to the point where it has become part of the hull girder and subsequently bear stresses caused by longitudinal bending. Since the current deckhouse is constructed of aluminum and the scantlings were not sized to carry hull girder stresses, structural cracking would be a valid concern.

This modification entails splitting the single deckhouse into two pieces and creating a gap between them. The deckhouse will no longer be continuous and will not be subject to hull girder bending. The summation of area in the two deckhouses will be equal to the area of the current, single deckhouse

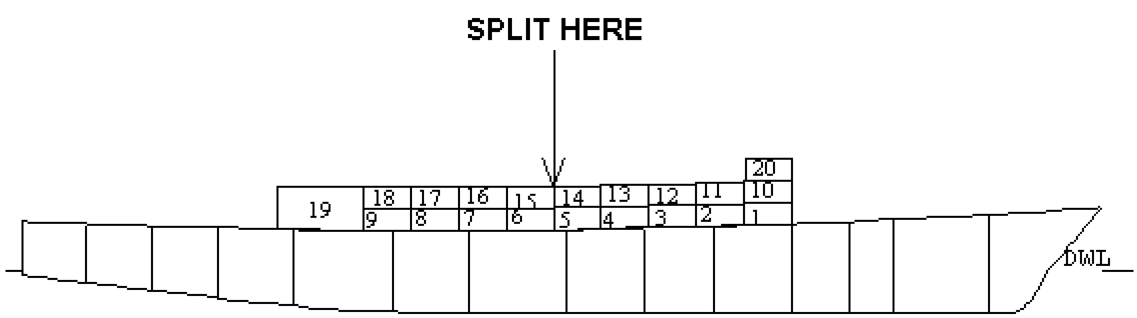
Instead of arbitrarily sizing the gap between deckhouses, use a rationale based on factors linked to the weather deck arrangement. Generate Graphic Report #1 in the Deckhouse Module. This is the plan and profile view of the current model's deckhouse.



Compare this to the preliminary inboard profile that was created before running ASSET (Sect 6.3). On the preliminary inboard profile, the aft boundary of the deckhouse was placed such that just enough room was provided aft for the helicopter pad and ship's mooring gear. When ASSET sized the deckhouse, it started at the forward limit of 0.25LBP (which is a default value set by ASSET in DKHS LIMIT ARRAY) and added length aft until the area requirements were satisfied. This method left space aft of the deckhouse in excess of that needed for the landing pad and mooring gear. To follow the original arrangement, you will split the deckhouse and align the aft portion's aft boundary so that only enough area exists aft of the deckhouse to accommodate the landing pad and mooring gear (per the preliminary inboard profile). The forward deckhouse will not move, creating a gap amidships.

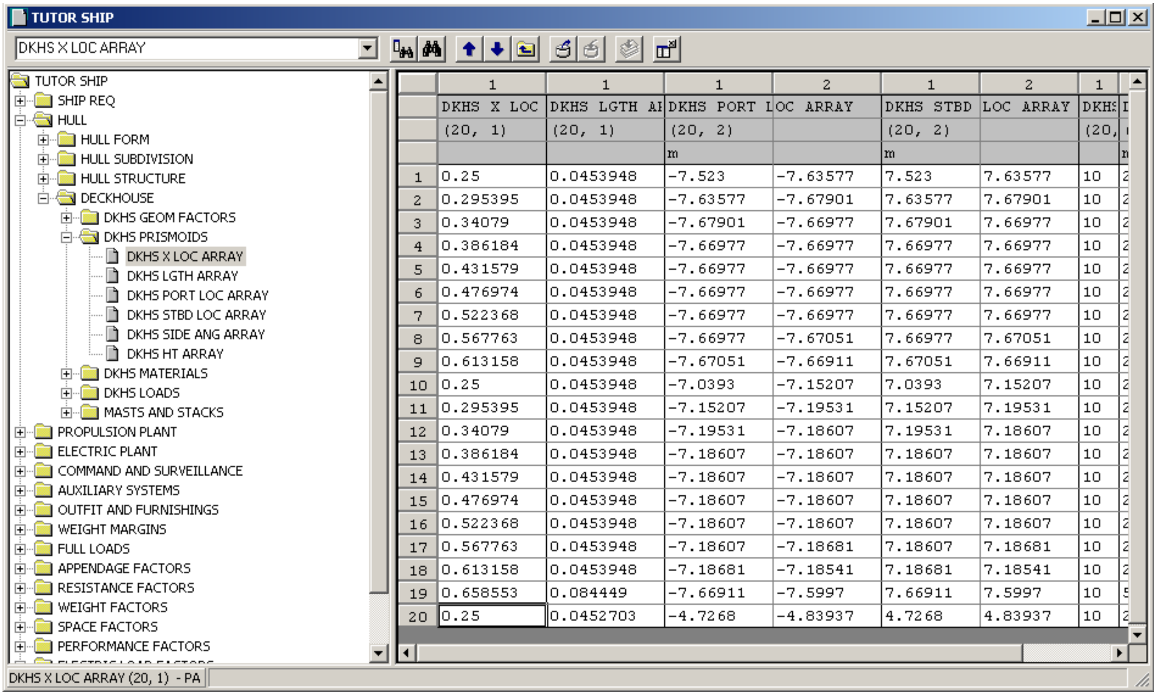
Measuring from the preliminary inboard profile, establish at what fraction of the LBP does the aft deckhouse boundary lie. Your calculation should place the aft boundary at 0.81LBP. Two parameters that affect deckhouse location and size are DKHS X LOC ARRAY and DKHS LGTH ARRAY, respectively. Use on-line help to fully understand these parameters. Print out a copy of these parameters' values in your current model.
ASSET constructs the deckhouse from prismoids. The DKHS X LOC ARRAY sets the forward position of each prismoid. The DKHS LGTH ARRAY sets the longitudinal extent of each prismoid. Working with these two parameters, you will move certain prismoid boundaries aft, while keeping their lengths the same.

The DKHS X LOC ARRAY and DKHS LGTH ARRAY parameters are matrices. Each row in the DKHS X LOC ARRAY corresponds to the same row in the DKHS LGTH ARRAY. These corresponding rows define the longitudinal position and extent of one prismoid. Using the on-line help and looking at these two parameters, you should be able to determine the location of the prismoids in the deckhouse profile. Following is a numbered deckhouse profile. The numbers on the drawing correspond to the rows in the DKHS X LOC ARRAY and DKHS LGTH ARRAY.



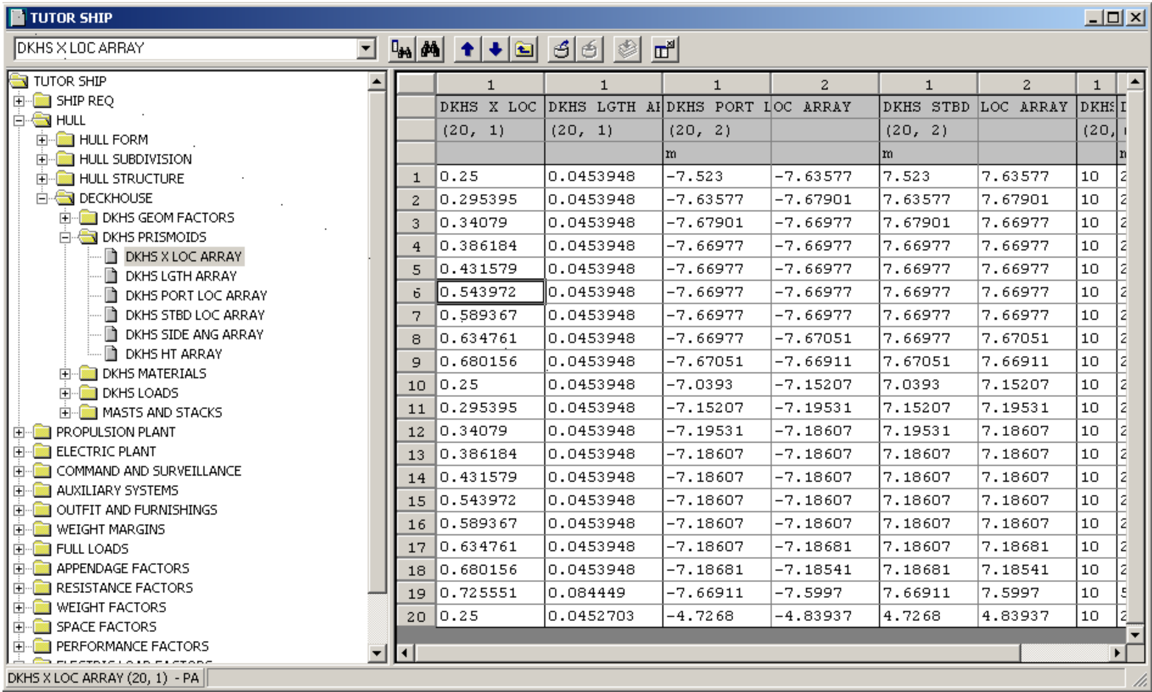
The first change to make is to set the DKHS GEOM IND to **GIVEN**. Currently the indicator is set to **GENERATE**. Since you now want to control the size and shape of the deckhouse, the DKHS GEOM IND needs to be set to **GIVEN**.

To shift the aft portion of the deckhouse, you need to edit the DKHS X LOC ARRAY.



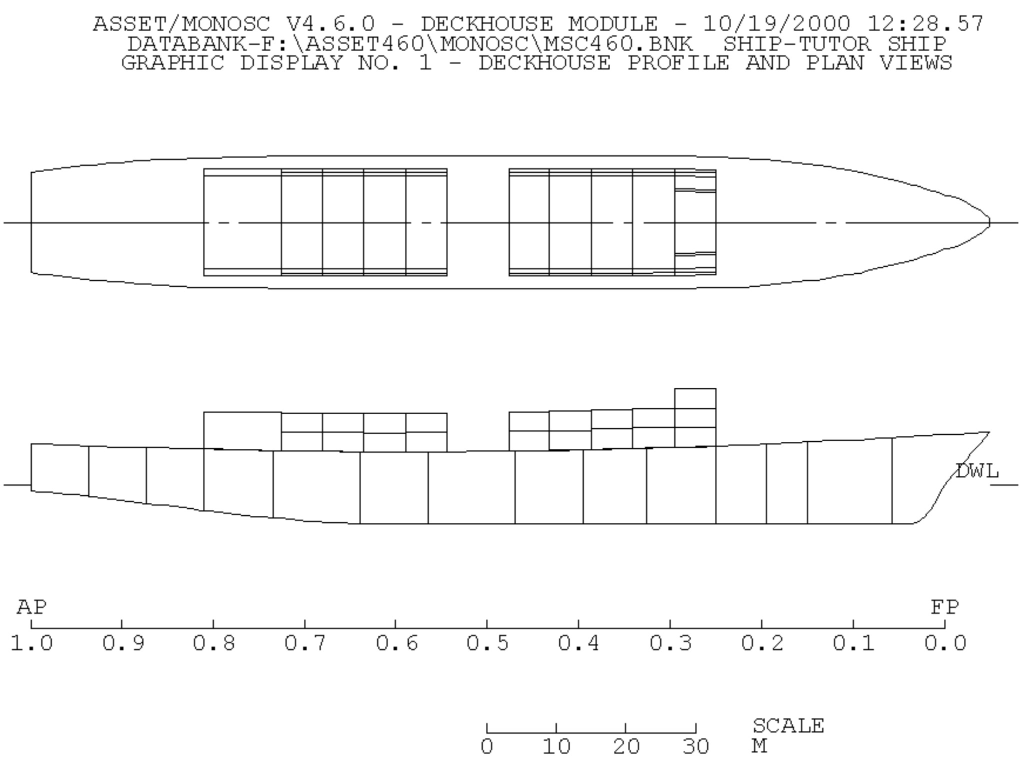
	1	1	1	2	1	2	1
	DKHS X LOC	DKHS LGTH AI	DKHS PORT LOC ARRAY		DKHS STBD LOC ARRAY		DKHS
	(20, 1)	(20, 1)	(20, 2)		(20, 2)		(20,
			m		m		
1	0.25	0.0453948	-7.523	-7.63577	7.523	7.63577	10
2	0.295395	0.0453948	-7.63577	-7.67901	7.63577	7.67901	10
3	0.34079	0.0453948	-7.67901	-7.66977	7.67901	7.66977	10
4	0.386184	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
5	0.431579	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
6	0.476974	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
7	0.522368	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
8	0.567763	0.0453948	-7.66977	-7.67051	7.66977	7.67051	10
9	0.613158	0.0453948	-7.67051	-7.66911	7.67051	7.66911	10
10	0.25	0.0453948	-7.0393	-7.15207	7.0393	7.15207	10
11	0.295395	0.0453948	-7.15207	-7.19531	7.15207	7.19531	10
12	0.34079	0.0453948	-7.19531	-7.18607	7.19531	7.18607	10
13	0.386184	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
14	0.431579	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
15	0.476974	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
16	0.522368	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
17	0.567763	0.0453948	-7.18607	-7.18681	7.18607	7.18681	10
18	0.613158	0.0453948	-7.18681	-7.18541	7.18681	7.18541	10
19	0.658553	0.084449	-7.66911	-7.5997	7.66911	7.5997	10
20	0.25	0.0452703	-4.7268	-4.83937	4.7268	4.83937	10

For prismoids 6-9 and 15-19 shift their locations so that prismoid 19's aft boundary lies at the 0.81 LBP mark. To do this, start at prismoid 19. Subtract the length of the prismoid—**0.0829085**—from the position where you want the aft location of prismoid 19 to be—**0.81**. The difference will be the forward location of prismoid 19. This value goes into the table. To get the forward locations of prismoids 15-18, you take the value of the prismoid before it and subtract the length of the prismoid. That is, to get the forward location of prismoid 18, you subtract the length of prismoid 18 from the forward location of prismoid 19. After you calculate the forward locations of prismoids 15-18, place these values in the table. You then copy these values in the forward locations of prismoids 6-9. Do not change the prismoid length since the deckhouse area is to remain constant. This is what the table is to look like:



	1	1	1	2	1	2	1
	DKHS X LOC	DKHS LGTH AI	DKHS PORT LOC ARRAY		DKHS STBD LOC ARRAY		DKHS
	(20, 1)	(20, 1)	(20, 2)		(20, 2)		(20,
			m		m		
1	0.25	0.0453948	-7.523	-7.63577	7.523	7.63577	10
2	0.295395	0.0453948	-7.63577	-7.67901	7.63577	7.67901	10
3	0.34079	0.0453948	-7.67901	-7.66977	7.67901	7.66977	10
4	0.386184	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
5	0.431579	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
6	0.543972	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
7	0.589367	0.0453948	-7.66977	-7.66977	7.66977	7.66977	10
8	0.634761	0.0453948	-7.66977	-7.67051	7.66977	7.67051	10
9	0.680156	0.0453948	-7.67051	-7.66911	7.67051	7.66911	10
10	0.25	0.0453948	-7.0393	-7.15207	7.0393	7.15207	10
11	0.295395	0.0453948	-7.15207	-7.19531	7.15207	7.19531	10
12	0.34079	0.0453948	-7.19531	-7.18607	7.19531	7.18607	10
13	0.386184	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
14	0.431579	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
15	0.543972	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
16	0.589367	0.0453948	-7.18607	-7.18607	7.18607	7.18607	10
17	0.634761	0.0453948	-7.18607	-7.18681	7.18607	7.18681	10
18	0.680156	0.0453948	-7.18681	-7.18541	7.18681	7.18541	10
19	0.725551	0.084449	-7.66911	-7.5997	7.66911	7.5997	10
20	0.25	0.0452703	-4.7268	-4.83937	4.7268	4.83937	10

After you are done, run the Deckhouse Module. Compare the inboard deckhouse profile with the one included. When you have shifted the deckhouse properly, run Synthesis to incorporate the new change.



6.19.2 ELECTRIC DRIVE

This section outlines the required steps to convert the diesel propulsion plant to an electric drive/gas turbine plant. Many different types of electric drive systems can be modeled in ASSET. For this tutorial, an Integrated Propulsion System (IPS) has been chosen.

The basic procedure for electric drive conversion is to use the Machinery Module Wizard to set the few key parameters that indicate that an electric drive system is present. From there, the Machinery Module can be run and will prompt you to enter the remaining parameter values.

Input the following values in the Machinery Module Wizard (<u>Note</u>: Be sure to look-up each parameter in the on-line help):

<u>Propulsion Transmission Type</u>
Transmission Type: **Electrical**
Shaft Support System: **Tractor Pod**

<u>Propulsion Engine Configuration</u>
Engine Categories: **Only Main Engines Exist**
Engine Types—Main: **Gas Turbine Engine**
Input Ship Sustained Speed (box not checked): **Let ASSET calculate sustained speed**
Input Ship Endurance Speed (box checked): **18 knots**

<u>Ship Service Configuration</u>
Ship Service KW Ratings: **Calculate By Module—Standard**
Conventional Ship Service Engine Generator Set: **Domestic Diesel Engine**

Propulsion-Derived Ship Service System: **DC Bus Zonal Electric Distribution (ZED) System**

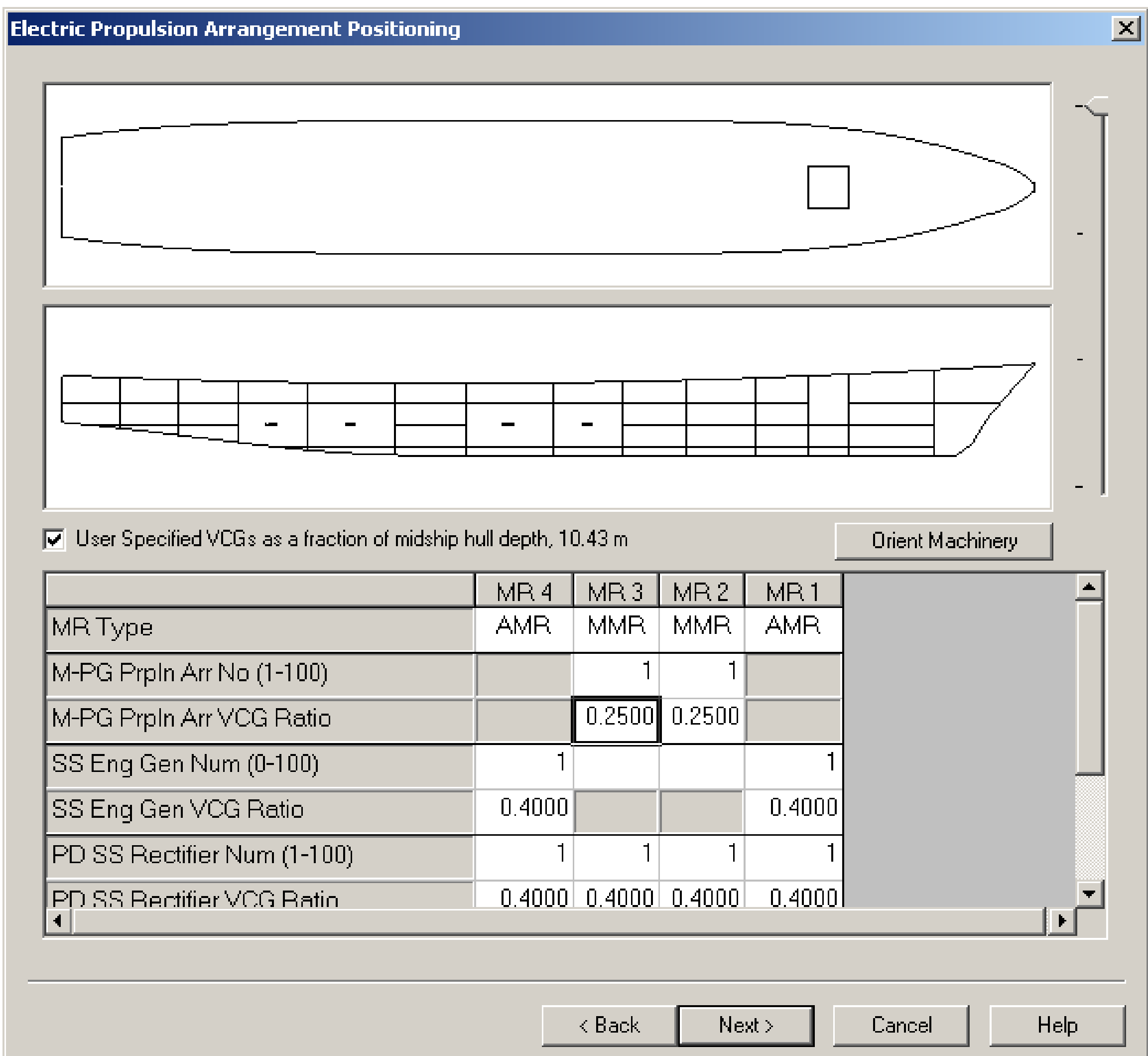
Electric Propulsion Arrangement Selection

Motor Type: **AC Synchronous**

Propulsion Engine Generator Arrangements—**Required First: M-PG**

Motor Arrangement: **Double Reduction**

Electric Propulsion Arrangement Positioning (see illustration)



Parameters Not Shown:

PD SS .25 MW Inverter No. (1-100): **7 7 7 7**

PD SS Inverter VCG Ratio: **0.4000 0.4000 0.4000 0.4000**

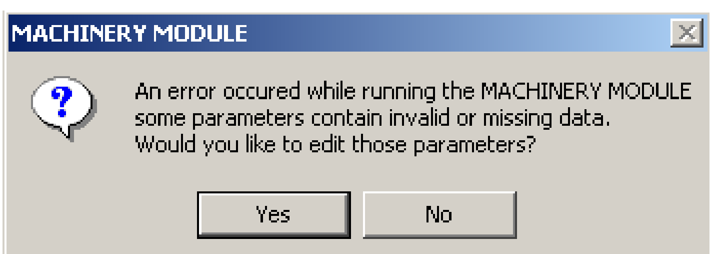
Note: Entering **1 1 1 1** in the **PD SS Rectifier Num (1-100)**, places a rectifier in each MR (a rectifier is required for each generator). When you enter **7 7 7 7** in the **PD SS .25MW Inverter No (1-100)**, this evenly distributes the 28 rectifiers needed by the ship's service electric system. The required number of inverters was obtained by dividing the connected load (MAX MARG ELECT LOAD) of 3485.5 KW by the rating of each rectifier (250 KW) and doubling the number to provide redundancy. These inverters are actually located throughout the ship, in a distribution that is related to the location of the electrical load demand. A more accurate model could be accomplished by defining several OMRs (Other Machinery Rooms) and placing the inverters therein. For expedience, we have evenly distributed the inverters in the existing machinery rooms.

Main Propulsion Engine Specifications (box checked)

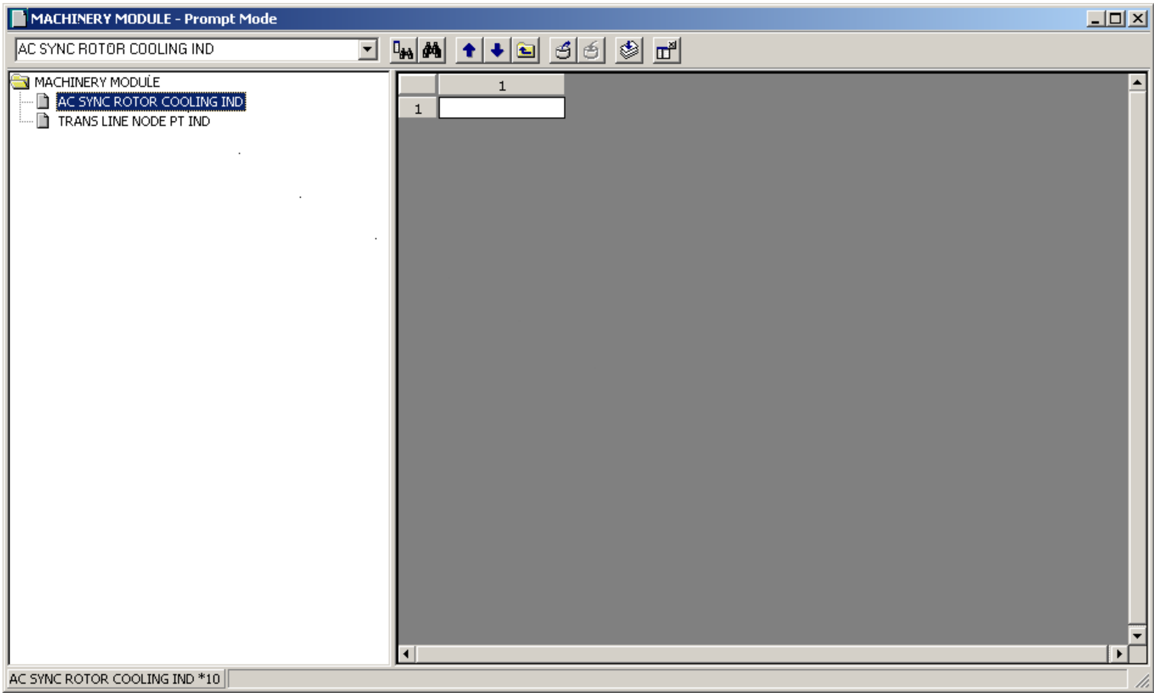
GE LM 2500-21

Ship Service Engine Specifications (box not checked)
Let ASSET choose SS engine

After you click **Finish**, run the Machinery Module. You will be given an error message:



After clicking 'Yes', you will be shown the following MACHINERY MODULE editor dialog box:

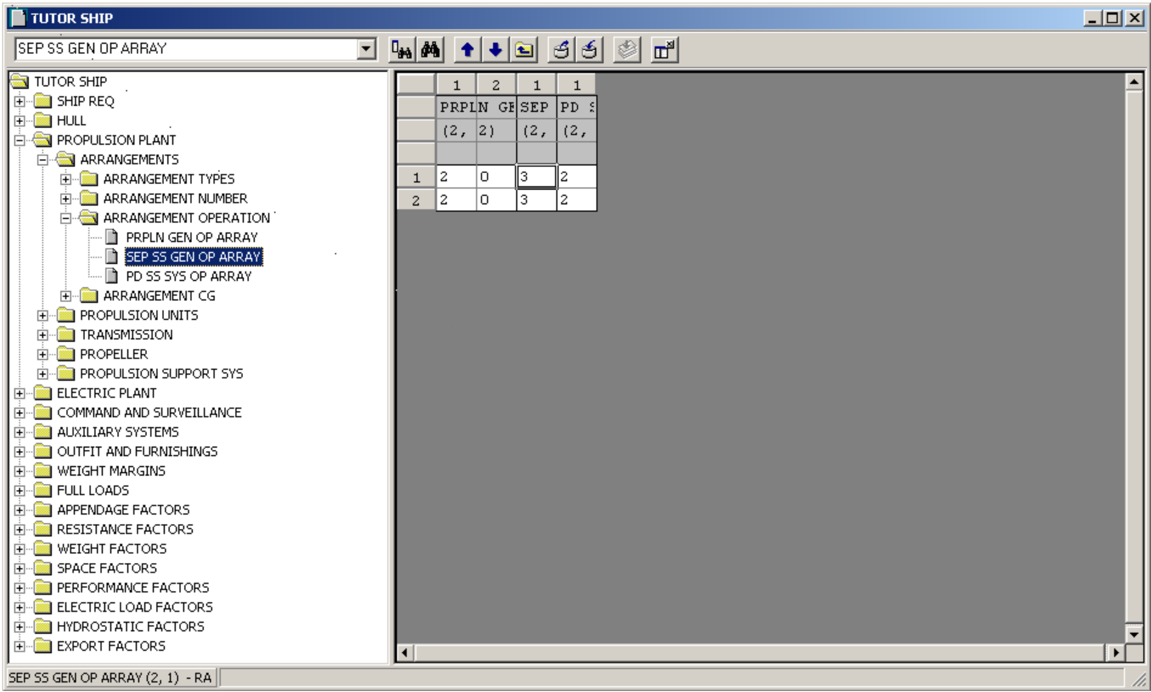


Make the following selections:

AC SYNC ROTOR COOLING IND: **AIR**

TRANS LINE NODE PT IND: **CALC**

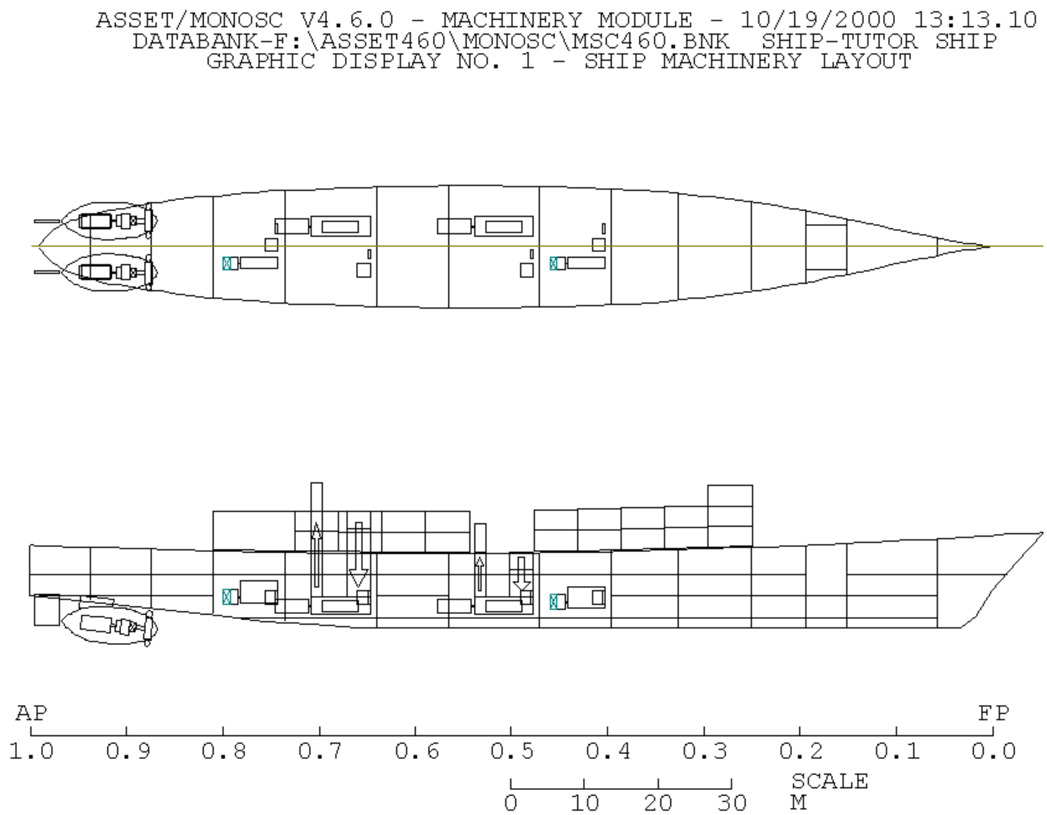
At this point the MACHINERY MODULE will attempt to run again and will give you a fatal error. Having more Ship Service Generator sets online than you now have installed causes this error. Open the editor once again and find the SEP SS GEN OP ARRAY parameter.



Set the SEP SS GEN OP ARRAY parameter such that you have 2 online in both conditions. Rerun the MACHINERY MODULE to see if you have any other errors.

Run Synthesis to converge your model. Check the machinery box (Machinery module Graphic report #2). The hull has changed enough to reduce the clearance between it and the propulsion machinery. The KGs need to be readjusted. Try **0.29**,**0.29** for MAIN ENG KG ARRAY. Additionally, the aft ship's service diesel-generator must be raised. Set its KG (SS ENG KG ARRAY) to **0.47**.

Run the Machinery Module. This is what the redesigned ship looks like:



Run Synthesis to converge your model.